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NEW SYSTEM

OF

Practical Husbandry.

By JOHN MILLS, Esq; F.R.S.

Member of the Royal Societies of Agriculture of Paris and
of Rouën, and of the ~~CE~~conomical Society of Berne.

Omnium rerum ex quibus aliquid conquiritur, nihil est
AGRICULTURA melius, nihil uberius, nihil dulcius,
nihil homine, nihil libero dignius.

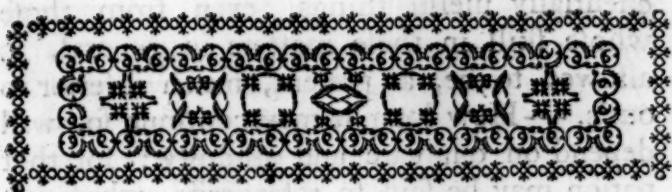
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V O L. III.

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M D C C L X V I I.



P R E F A C E.

OUR utmost attention to Agriculture never was more necessary than at this period, if we would preserve that superiority which we have hitherto enjoyed over every nation in Europe; except, perhaps, the inhabitants of the Austrian Netherlands, and those of the united Provinces, whose love of liberty, joined to an indefatigable spirit of industry, has rendered them singularly careful to improve their husbandry, which they wisely look upon as the surest basis of independence.---- Such we also have long experienced it to be; and such we shall ever find it, so long as we continue to cherish this origin of our power. --- But, let us beware of too great security: --- let not a fond opinion of our now justly claimed pre-eminence in this art induce us to imagine, that no other people will, at any time, be able to equal us therein. Daily experience proves that, with all our knowledge, we may yet learn many

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essentially useful things, even from those whose skill in these matters in general, is allowed to be, at present, much inferior to our's. --- How long it may continue so, will depend on our care and assiduity: for that nation may be said to retrograde, whose industry stands still, while that of her neighbours proceeds with unremitted diligence. That the former is not actually our case, is certain: but at the same time, the daily proficiency of the French in affairs of agriculture, of which we have seen many very striking instances in the course of this work, ought, whilst we justly admire and applaud it, to be to us the strongest of inducements to exert ourselves, in order still to keep before them. Their efforts to overtake us will undoubtedly be redoubled now, that their king has wisely instituted a Royal Society of Agriculture, and condescended to declare himself the immediate patron and protector of every rational endeavour to improve the science of husbandry. --- A similar Institution here, under the auspices of our most gracious Sovereign, would add new splendor to the British Throne, and firmly establish the possession of all our real advantages.

“ They who judge of the agriculture of
“ a whole country by the flourishing condi-
“ tion of a few districts just around it's cities
“ or great towns, judge too hastily”; as is
rightly observed in the preface to the third
volume of the Memoirs of the excellent
Society

P R E F A C E. iii

Society of Berne^a. “ The comparison of
 “ those places, generally favoured by nature,
 “ and always assisted by art, serves only to
 “ shew what industry and good culture
 “ might do with lands which lie totally
 “ neglected.

“ The resources of good husbandry are as
 “ infinite, as the fruitfulness of the earth is
 “ inexhaustible, when this is rightly cultivat-
 “ ed^b. Providence, in enabling it to yield
 “ innumerable various productions, seems to
 “ have intended it for the support of a race
 “ of men much more numerous than the
 “ present race, greedy as these are to possess
 “ more than they know what to do with,
 “ and madly bent upon destroying one ano-
 “ ther for the transient property of super-
 “ fluous land.

“ Never, perhaps, did nations attempt to
 “ rival each other in Agriculture, more
 “ strongly than they now do. We see among
 “ them all a noble emulation, which promises
 “ a happy revolution in favour of mankind.
 “ Genius, after having dwelt successively on
 “ all the speculative sciences, now chooses to
 “ fix upon objects which are immediately
 “ connected with the welfare of Society.

“ Many excellent men, and many good
 “ writers, have made the commerce, the arts,
 “ the finances, in short, all the resources of
 “ the power of states their principal, if not

^a Page 14.

^b Page 18. and 19.

“ their only, study. So many voices have
“ been raised on all sides, that kings have at
“ length been persuaded to measure the
“ strength of their sceptre by the number
“ and welfare of their subjects. Mighty fleets,
“ numerous troops, and strongly fortified
“ places, are now the means by which every
“ state secures it's public tranquillity, and pro-
“ tects it's frontiers. These formidable pre-
“ paratives are made only by dint of men
“ and money. The latter is derived from the
“ industry of the subject, the former depends
“ on population; and the primary cause of
“ this double means of all power is in agri-
“ culture. Alliances, victories, and even new
“ conquests, give to a nation but a momen-
“ tary and precarious power: the revenues
“ arising from an increase of industry, or from
“ an enlarged commerce, both of which are
“ the happy effects of a vigilant and active
“ administration, increase the relative power
“ of a state; but still that power is only con-
“ ditional and dependant. The resources of
“ the earth, and the strength of population,
“ can alone be looked upon as the founda-
“ tions of a sure and positive power, and as
“ the means by which a nation is enabled to
“ suffice for itself.”

Not having been able to comprise in my
second volume every article relative to the
management of grain; I have, in this, treat-
ed first of the Enemies to Corn, beginning
with

with Weeds, than which no one requires more the attention, industry, and perseverance of the farmer, who must extirpate them before he can have complete crops. I then point out the several kinds of Vermin most noxious to the husbandman, and indicate the most approved methods of guarding against, or destroying them. Here, a full account is given of that formidable insect which has long desolated, and had at length almost entirely laid waste, a whole province in France. The nearness of our situation to some parts of that kingdom, and the parity of latitude between France and some of our colonies, where the same circumstances in the air may be productive of the same effects, if any of it's eggs should unfortunately chance to be brought here, or carried thither, rendered it necessary to expatiate on the means of destroying that amazingly pernicious brood: and this I have done the more readily, as the same precautions bid fair to extirpate every other insect that breeds in corn. --- When I say, that my guide in this has been M. DUHAMEL, the reader will justly expect that accuracy which distinguishes his works, and that success which here happily attended his labour. --- The preservation of Corn, both in granaries, and in transporting it in ships, an article of considerable importance to every maritime nation, concludes the second part of this treatise.

Pastures,

Pastures, taken in a much more extensive sense than the generality of writers on agriculture have hitherto considered them, are the subject of my third part; in which, comprehending under that name whatever is, or may be, properly used for the food of cattle, I begin my first chapter with treating of such plants as may be cultivated interchangeably with corn or pulse. Almost the whole of this is new, in the light here represented, and therefore will, I hope, be of proportionably greater service; because it creates a fund of pasture, hitherto little known in this country. ---- The second chapter treats of what is commonly called artificial grass: an article from which our farmers have of late experienced many great advantages, but which they have not yet carried to near the perfection of which the experiments here related prove it to be susceptible.

In the third chapter of this part, I have endeavoured to draw a fair comparison between the old husbandry and the new, by relating facts, which speak for themselves, and seem plainly to shew, that though the advantages of the horse-hoeing method may not be immediate, or very striking, in the culture of corn; they are indisputable in that of pulse, or roots, and of various articles which have lately enriched the essential article of Pastures. Thus much is evident, even from the few trials that have been made of it in this kingdom.

dom. --- I am sorry to say the *few*: but hope my countrymen will soon set examples, which (excepting the experiments communicated by three patriots * *only*, in all this kingdom!) I have hitherto been obliged to borrow from foreigners.

As almost every country, especially if the climate differs, has it's particular sorts of natural grasses, which are the subject of my fourth chapter; I have here pointed out the means of ascertaining the comparative value of each, and have given particular descriptions and drawings of such as promise the best success in this country.

The appendix at the end of this chapter was occasioned by a letter with which I was honoured by that excellent patriot the Marquis of Turbilly, who, with that admirable greatness of mind which studies to extend every part of useful knowledge, was pleased to send me a particular account of the culture of the great Anjou cabbage: but too late to be inserted in a more proper place.

My fifth chapter treats of a part of husbandry in which the English have hitherto greatly excelled every other people: I mean, the inclosing of land; from which we daily

* One of these, whose cultivation of lucerne in Surrey is mentioned in p. 247 of this volume, has informed me, since that account was published, that no dung, or manure of any kind, has ever been used upon his land, since it's being under the lucerne. — The reader will be pleased to remember this remark.

reap such vast advantages, as leave room only to wonder, that there should yet remain among us prodigious tracts of now absolutely waste, though in fact, highly improveable, land. ---- How immensely might the power and wealth of this nation, the splendor and revenues of the crown, and that most important object, population, the true bulwark of the strength and glory of a state, be increased, by inclosing and cultivating many parts of the extensive forests, heaths, and commons, in this puissant kingdom! The infinite benefits that would accrue therefrom, are evident to a demonstration.

I close this volume with a subject truly interesting to every inhabitant of the country, *viz.* the choice of proper situations to live in: for on that the health, and consequently the welfare, of them all must greatly depend.

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Place all the Plates so that they may open towards the

Right-hand.

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PRACTICAL HUSBANDRY.

PART. II.

CHAP. III.

OF ENEMIES TO CORN.



BESIDES the distempers treated of at the end of the preceding volume of this work*, and which might have been ranked under the general title of this chapter; corn is exposed to many other accidents, before it sprouts in the earth, while it grows, and after it is laid up in stacks, barns, or granaries. The careful husbandman will exert his utmost endeavours to guard against these evils, which proceed chiefly from weeds, vermin, and insects; for the remov-

* See Vol. II. p. 381---429.

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ing and destroying of which I shall point out the methods hitherto best warranted by repeated experience, taking them progressively as they affect the corn, from the time of it's being sown.

The damages occasioned by inclement seasons, storms, high winds, hail, violent rains, and other such like events, cannot be totally prevented by any human prudence; though proper inclosures, which will be spoken of hereafter, will contribute greatly to abate their mischievous effects. The farmer can do nothing more to his corn fields for some time after he has sowed them, than to take care that his fences, drains, and ditches be in good order.

As to hard winters, they are frequently of service to corn in many respects; especially if the land has been thoroughly drained, and is well covered with snow. This last mellows the ground and keeps it warm; while frost, neither the rigour nor duration of which need be feared if it comes on gradually, and the land is dry, not only kills great numbers of vermin and insects, but, by leaving the earth in a loose state, fits it for roots to extend themselves therein as the warmth of the spring approaches, and thereby enables them to produce strong plants: whereas frequent rains in the winter, without frost, sadden the earth, which afterwards produces nothing but blades, soon to be destroyed by the hoar-frosts of the spring, by insects, and by weeds, or which would yield at most only straw without grain. The winter's frosts may indeed nip off the blades; but then, the roots being unhurt, new ones will shoot up in the spring. This was the case in the remarkably severe winter of 1608, of which Mezeray speaks, and which, notwithstanding it's extreme severity, was followed by a plentiful harvest; and such also, or nearly such, was the long winter of 1729*.

The

The great danger from frosts is when the earth is wet and not covered with snow: for example, if a strong frost returns after a sudden thaw, the fibres of the roots are broken by the expansion of the surrounding water when frozen, and the too great abundance of moisture in the plants themselves, when frozen, tears their fibres to pieces by the same expansion. This was what happened in 1684†.

Early in the spring of 1710, the parliament of Paris, hoping that the corn cut off by the preceding winter would shoot out again, as it did after the winter of 1608, mentioned by Mezeray, forbid sowing anew the lands which had been sown the autumn before: but the expectation now proved groundless; the plants having been totally destroyed by repeated frosts intermixed with frequent thaws: so that had it not been for the barley that was sowed afterwards, which yielded such prodigious crops that the French still call that year the *year of barley*, (*l'année des orges*,) the dearth must have been much more dreadful than it was. In that very spring, after the hard winter, several people in the dutchy of Berry and elsewhere sowed wheat, which sprouted well, and grew, but did not spindle; whereupon some mowed their crops, and others turned in cattle, to feed as in a meadow: but after another winter had passed over them, those very fields yielded, the next year, as plentifully as if they had been sown anew. In inclosed grounds, the corn near hedges which screened it from the north wind, resisted all the rigour of that excessive cold: and in other places, where the poor peasants raked up all the snow they could collect,

* *Maisons Rustiques*, Tom. I. p. 638. † *Ibid.*

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and spread it with their hands upon the uncovered spots of their small fields, their corn was preserved, and yielded a good crop.

A gentleman now living in England had a field of wheat so greatly damaged by alternate frost and thaw, that the neighbouring farmers thought he could not do better than plow it up for spring corn. But, observing that many of the plants were yet alive, and in a condition to be recovered, though thinly scattered, he hand-hoed the whole, and reaped three quarters of corn from each acre of this land.

An extremely wet and rainy spring is generally followed by a very bad harvest, because the corn has then been choaked and starved by a multitude of weeds. Those are likewise the years in which distempers are most apt to reign among the common people in the autumn; owing, perhaps, to the bad quality of the corn, which has not had sufficient nourishment, or to it's being greatly mixed with the seeds of weeds.

The blooming season of the corn generally decides the fate of the ensuing harvest. It may be expected to be good, if the corn then stands well and is strong; unless some of those fatal accidents, which the power of man cannot guard against, such as hail or blight, should unhappily frustrate the husbandman's otherwise well grounded hope. His principal care at this season must be, to keep his ground free from weeds; a subject which, though treated of before in a general manner*, is of such importance as will justify my adding here some more particular remarks.

* *Id. ibid.* p. 939.

* See *Vol. I.* 284---288.

OF ENEMIES TO CORN.

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S E C T. I.

Of Weeds.

THE judicious farmer will not attempt to weed his corn before the beginning of spring, on account of the great danger of pulling up many of the young useful plants, with those which he wants to extirpate: and yet he should not wait too long before he sets about this very necessary work; because the noxious growth will multiply apace, and speedily rob the soil of great part of it's nutritive juices. His eye must help to direct him when to perform this essential operation; and he must, above all, be particularly careful never to let any weeds grow so big as to choak or overtop his corn, or stand till their seeds ripen and sow themselves. This last accident is most to be feared from the lesser kind of weeds, which are too often passed over un-heeded, and of which the increased multitudes soon become extremely prejudicial. Repeated weedings are therefore indispensably necessary; that what has escaped at one time, may be noticed at another, and that the pernicious race may be rooted out as fast as it appears. The first weeding should be as early in the spring as it is possible to distinguish which are weeds, and which are not; and the same business should be repeated, for the second time, at farthest when the corn has begun to spindle. It frequently is for want of good weeding that we meet with so many lank half-starved ears, which afford only meagre, shrivelled, spotted, unwholsome grains, disagreeable to the taste, and not half so full of flour as those of sound corn.

The best time for weeding by hand is after a gentle shower has moistened the surface of the

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earth: because the weeds are then most easily drawn out with their roots, which are apt to break when the ground is too dry; and in this case the remaining pieces, particularly of those which are of the creeping perennial kind, will soon produce new shoots, which will become as hurtful as the old ones.

If the spring is wet and warm, and if it rains much in May, abundance of weeds will then spring up, and great care should be taken to destroy them immediately. The mild showers which are sometimes almost continual in June, produce the same disadvantageous effect. Then, especially, it is that every species of the bind-weed shoots up with vast rapidity, twirls itself round the corn, reaches it's top-most height in eight or ten days, and drags it down so as to deprive the ears of all farther sustenance. Only the warm rains in June, and not the cold ones, engender this noxious production. Particular care should therefore be taken to pluck up all weeds, and singularly this, in April, May, and June: otherwise there will be danger of reaping straw only, instead of corn.

The weeds themselves may be given to cattle, either green, or dried in the sun. If dried, they should be laid in heaps to sweat; after which they may be used as hay. The poor in many countries are glad to have them for the reward of their labour in picking them out from among the corn.

But these instructions are only for the slovenly farmer: for such crops of weeds never appear in ground in due order. I shall therefore point out the most effectual means of eradicating them entirely. These are different, according to the different qualities of the weeds; namely, whether they are propagated by their roots and seeds, but chiefly by their roots; or by their seeds alone,
for

OF ENEMIES TO CORN. 9

for each of these requires a different treatment. And I shall also mention, in the course of this detail, some of the profitable uses that are or may be made of several of these enemies to corn, or of the species belonging to them.

Of the perennial rooted kind, which are best destroyed by repeated summer fallows, wherein it is essentially material that every piece of root be taken away and burnt, because, in many of such, every joint will produce a new plant; the most hurtful to the farmer, and the most apt to abound, are the

Bind-weed, by some called with-wind (*Cenocaulus*), of which, considered as a weed, there are two principal sorts, the great and the small. It's root is perennial, but it's stalk annual. Mr. Lisle, after observing that he believes it propagates itself in pasture ground chiefly by it's seeds, and by it's roots in arable land, because it seems to flower too late in corn, to seed before the corn is cut; rightly assigns as a reason why it is most apt to multiply in strong clayey soils, that such ground being, in the common practice, plowed only in the winter months, after wheat, for such other crops as peas, barley, or oats, and not till about September for winter-vetches; this tillage cannot destroy the roots or seeds of weeds like the summer-fallows for wheat; but, on the contrary, promotes their increase, particularly from the off-sets or joints of the roots. "I have known," says he, "in this case, clay-land folded for barley, and particularly that part of it which, waiting for the folds going over it last, was latest fallowed, bring up so great an increase of with-wind, that, though the spring and summer had been very dry, every stem of barley had a with-

* *Observations in Husbandry, Vol. 303. 2d. Edit.*

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“ wind round it. As the fold brought up a crop
 “ of this corn, it brought up with each plant it's
 “ enemy, which would eat it out, pull it down
 “ before it could ripen, and thereby prevent the
 “ filling of the grain. The crop is also greatly
 “ hazarded here, after it is cut, by the danger it
 “ must run by laying in swarth till this weed is
 “ withered, before it can be carted.—Again, near
 “ the end of the first summer, after the first year
 “ of a crop of hop-clover, which I fed, that is,
 “ about the beginning of August, I fallowed a
 “ ground for wheat, then dunged the fallows, and
 “ sowed my wheat before Michaelmas. I had a
 “ very good crop of wheat; but a with-wind
 “ came up to every plant; so that had it been a
 “ wet and cold summer, instead of a hot and dry
 “ one as it chanced to be, my corn would have
 “ been pulled down and lodged while green in the
 “ ear, and in the milk, and could not then have
 “ filled in body and flour, but must have been of
 “ the nature of blighted corn. The increase of the
 “ with-wind here was, without doubt, occasioned
 “ by the laying down this ground only to one
 “ summer-feed after the hop-clover was sown,
 “ when it had borne three or four crops of sum-
 “ mer-corn after it's wheat crop: for by the
 “ winter plowings, as I intimated before, the off-
 “ sets of the roots of weeds, and their seeds, were
 “ propagated. I could not conveniently destroy
 “ these roots or seeds by giving the ground a
 “ seasonable summer-fallow in the beginning of
 “ June, because I should have lost the fruits of
 “ my hop-clover crop, by plowing it in at the be-
 “ ginning of the first summer; though this would
 “ have contributed much to the killing of the
 “ with-wind: whereas by delaying the fallowing
 “ three months longer, viz. to the beginning of
 “ August, when the sun had lost it's strength to
 “ burn

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“ burn up the roots and malt the seeds, and it
 “ was too late for the ground to lie long to a
 “ fallow, the dung laid on the fallows gave new
 “ life to the roots and seeds.”

Mr. Philip Miller, who enumerates thirty-two sorts of *Convolvuli*, of which only the two before mentioned are deemed weeds, is very certain * that the *Convolvulus foliis variis, pedunculis unifloris, radice tuberosâ*, or bind-weed with variable leaves; footstalks with single flowers, and a tuberous root, is the true medicinal Jalap, which now grows naturally at Haleppo; between La vera Cruz and Mexico. This was first suspected by the learned Mr. Ray, and afterwards ascertained by the late Dr. Houstoun, who carried some of the roots of this plant from the West-Indies to Jamaica, where he planted them, and found them thrive. His design was to cultivate the Jalap there: But soon after he left that country, the person to whose custody the plants were committed, was so careless as to suffer hogs to root them out of the ground and destroy them, so that there were no remains of them left when he returned thither: nor is there any account of this useful plant's having been since introduced into any of the British islands; though the consumption of it is now so great, since the distillers and brewers have found out it's use for exciting a fermentation, that the cultivating of it in some of our warm colonies, for it is a tender plant, would become a national benefit: and this might be soon effected, if the inhabitants of those parts were a little more attentive to their own, and to the public good. It's importance, in this light, will be a sufficient apology for my having dwelt so long upon it here: for the quantity of it used in medicine is not alone suffi-

* *Gardener's Dict.* Art. CONVOLVULUS.

cient to render it an object of great concern; though it is esteemed an excellent cathartic, to purge off ferous or watery humours, and is of singular service in dropfical and rheumatic disorders. This species of the *Convolvulus* hath a large root, of an oval form, and full of a milky juice. From that root proceed many herbaceous twining stalks, which rise eight or ten feet high, and are garnished with variable leaves, some of them being heart-shaped, others angular, and others again pointed. They are smooth, and stand upon long foot-stalks; and the flowers are shaped like those of the common great bind-weed, each foot-stalk supporting one flower. The seeds are covered with a very white down, like cotton.

Nearly the same medicinal virtues are found in the *Convolvulus foliis reniformibus, pedunculis unifloris*, or Bind-weed with kidney shaped leaves, and one flower on each foot-stalk. This is the *Soldanella maritima minor*, or lesser sea Bind-weed, of Casper Bayhin, which grows naturally on the sea beach in many parts of England, but cannot be long preserved in a garden. It has many small white stringy roots, which spread wide, and send out several weak trailing branches, which twine about the neighbouring plants, like the common bind-weed, and are garnished with small kidney-shaped leaves.

Another medicinal sort of Bind-weed, distinguished by the appellation of *Convolvulus foliis cordatis, angulatis, caule membranaceo, quadrangulari, pedunculis multifloris*, Bind-weed with angular heart-shaped leaves, a quadrangular membranaceous stalk, and foot-stalks, having many flowers; likewise known by the name of *Convolvulus Zeylanicus, alatus, maximus, foliis Hibisci nonnihil similibus angulosis*, greatest, winged Bind-weed of Ceylon, with many cornered leaves not unlike the *alisbea*;
grows

grows naturally in the island of Ceylon. This is a perennial plant, has thick fleshy roots, which spread far in the ground, and abound with a milky juice, which flows out when the roots are broken, or wounded, and soon hardens into a resinous substance, when exposed to the sun and air. From the root shoot forth many twining branches, which twist about each other, or the neighbouring plants, like the common bind-weed. The roots of this plant, which is too tender to live in the open air in England, are the only part of it that is used in medicine. They are brought to us from India, and are called *Turpethum*, or *Turbith*, in the shops.

The *Convolvulus foliis sagittatis posicè truncatis, pedunculis bifloris*, or Bind-weed with arrow-pointed leaves torn behind, and two flowers on each foot-stalk, is the *Convolvulus Syriacus* and *Scammonia Syriaca*, Syrian Bind-weed, and Syrian Scammony. This grows naturally in Syria, where the roots of the plants are wounded on purpose to let out their milky juice, which is received in shells placed under the wounds, and thickens when exposed to the air. This is what we call Scammony. This species of the bind-weed is a very hardy plant, and will thrive well in the open air in England, provided it be on a dry soil. It's roots are thick, run deep in the ground, and are covered with a dark bark. It's branches, which are slender and trail on the ground, are garnished with narrow arrow-pointed leaves, and extend themselves on every side to the distance of three or four feet. In June and July it puts forth flowers of a pale yellow, and it's seeds ripen in autumn; at which time also the stalks decay, but the roots will abide many years. This and the preceding species will undoubtedly do well in some of our southern colonies; and our excellent Society for the Encouragement of Arts, &c. thinks this last, which
affords

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affords the Scammony, of such consequence as to offer a premium for the cultivating of it.

The species of Bind-weed which botanists term *Convolvulus foliis cordatis angulo-nervosis, caule repente tubifero*, Bind-weed with heart-shaped leaves, having angular nerves, and a creeping stalk bearing tubers, proceeds from the root which we generally call Spanish potatoe. These roots are annually imported from Spain and Portugal, where they are greatly cultivated for the table; and though they are too tender to thrive well in the open air in England, they may turn to good account in some of our American settlements. They are cultivated by the roots, in the same way as the common potatoe, but require much more room; for they send out many trailing stalks, which extend four or five feet every way, and at their joints put forth roots, which, in warm countries, grow to be large tubers; so that from a single root planted, forty or fifty large roots are produced.

The smaller field bind-weed, or gravel bind-weed, which is Casper Bauhin's *Convolvulus minor arvensis*, and Linnæus's *Convolvulus foliis sagittatis utrinque acutis, pedunculis unifloris*, Bind-weed with arrow-shaped leaves, pointed on both sides, and a single flower on each foot-stalk, is justly deemed a most pernicious weed. It is very common upon dry banks, and in gravelly grounds, in most parts of England, and is generally a sign of gravel lying under the surface. The roots of this shoot very deep into the ground, from whence some country people call it devil's guts.

The common larger sort is Bauhin's *Convolvulus major albus*, large white bind-weed, called Bear-bind. The stalks of this will rise ten or twelve feet high, twining themselves about trees and hedges, under which this species is most apt to grow. These stalks are garnished with large
arrow-

arrow-pointed leaves, torn at their base. The flowers come out from the side of the branches, upon long foot-stalks, each sustaining one large white flower. These flowers appear in June, and the seeds ripen in autumn, soon after which the stalks decay to the root: but as every small piece of the root will grow, this, as well as the former sort, is very troublesome to destroy. However, in an open clear spot of ground, good plowing and harrowing, or carefully hoeing down of these weeds as they rise, during three or four months, may extirpate them effectually: for when the stalks are broken or cut, a milky juice flows out, and the roots are thereby soon exhausted and decay. The roots of this sort are white, pretty thick, and extend far on every side.

Blue-bottle, which some call *Knap-weed*, others *Matfellow*, and others *Centaury* (*Centaurea*). Many of the species of this genus, of which Mr. Miller enumerates particularly twenty^e, have perennial roots; but that which Botanists distinguish by the appellation of *Centaury* with sawed empalements, very narrow entire leaves, indented below*, is Casper Bauhin's *Cyanus segetum*, and our common corn blue bottle, and is an annual plant, according to Mr. Miller, though Mr. Ray and Mr. Lisle think it's root perennial; because, says this last, it not only puts forth new buds every summer at the root, for the growth of the next year; but seems also not to seed early enough, before the corn is cut, to propagate itself by it's seed in corn lands, in which it most abounds, especially in a gravelly soil. From an old notion of it's being

^e Gardener's Dict. Art. CENTAUREA.

* *Centaurea calycibus serratis, foliis linearibus integerrimis, infimis dentatis.*

^f Observations in Husbandry, Vol. II. p. 311.

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good for scabs, scald-heads, &c. Some authors have given it the epithet of *Scabious*. It flowers in July, and it's seeds ripen in autumn.

Chick-weed, (*Cucubalus*) flowers early in the spring, and, if it be suffered to grow, several times in the course of the year. The way to destroy it is therefore to pluck it up from time to time, before it can shed it's seed. The berry-bearing sort, which grows with smooth erect stalks, globular empalements, and stamina longer than the petals†, is the wild *Lychnis*, or white *Beben* of the shops. This is a very rambling weed, natural to most parts of England, and is frequently called spatling poppy. It's roots are perennial, and strike so deep into the earth, that they are not easily destroyed by the plough; for which reason bunches of this plant are too common among corn in land which has not been perfectly well tilled. Summer fallows, and carefully harrowing out every part of the roots, which should then be burnt, will here prove the most effectual remedy.

Cockle or *Darnel* (*Lolium*), the seeds of which are black, and not easily separated from the grains of wheat, because they are heavy, and nearly the same size. Sifting and throwing the corn to a distance on a large floor, are the best ways of clearing it of these seeds, which discolour bread and give it a disagreeable taste, if they are ground with the corn. The darnel-grass, commonly called Ray or Rye-grass, is best extirpated in arable land by summer-fallows, good harrowing, and carefully removing every bit of it's long creeping perennial roots, which would soon produce new plants, if left upon the ground, and which should therefore be burnt as soon as they are taken off. The

† *Cucubalus caulibus erectis glabris, calycibus subglobosis, staminibus corollâ longioribus.*

horse-hoeing husbandry will soonest and most effectually accomplish the destruction of this growth.

Colt's-foot (*Tussilago*). This weed, which delights to grow by the sides of rivers, increases so fast by it's seeds and rambling roots, every piece of which last will produce a new plant, though they have been broken by the plough, that it cannot be extirpated without much difficulty, and a considerable time. Carefully pulling up the roots every time the earth is stirred, or the least vestige of the plant appears, and preventing it's running to seed, are the most effectual means of destroying it in arable land; and this is best accomplished by the horse-hoeing husbandry: but, totally to extirpate it, the ground must be laid down long to grass. One of Mr. Lisle's neighbours almost destroyed it by two successive crops of vetches; and he himself is clearly of opinion^a that it may be killed by letting the land lie a sufficient time under clover or rye-grass; because, says he, the roots of the natural grass matting more and more every year, will, in five or six years, so bind the surface of the ground, that the colt's-foot will not be able to pierce through it, and will therefore die for want of air. He plowed up broad clover in the beginning of July, and turned up the roots of colt's-foot, in which he observed, between earth and air, many little buds shot forth of the bigness of the Midsummer buds in fruit-trees; probably to be the leaves or flowers of the next year; and at the depth of five, six, and even seven inches, he remarked here and there a shoot, of a callous body, like the root itself, from one to four inches long; perhaps destined to be future roots. He experienced, that a winter's fallow will not destroy these roots; and that they cannot resist

^a Vol. II. p. 308.

the effect of summer fallows, in which they are turned up and exposed dry to the sun. It is therefore necessary to pick them up as clean as possible, and burn them: for it is not to be supposed that all the roots which are turned up in a summer fallow will wither of themselves: on the contrary, such of the buds at the joints of these as are buried under ground, and even many of those which only touch the ground, will shoot out again if much rain falls, or the season be wet.

Corn-flag (Gladiolus): This, multiplying exceedingly by it's roots, is a very troublesome weed in arable land in most of the warm countries in Europe, and is extremely difficult to root out. The manner of extirpating it is the same as for colt's-foot. It has a round compressed tuberous root, which is of a yellowish colour, and covered with a brown furrowed skin, like that of the vernal crocus. From this root arise two flat sword-shaped leaves, which embrace each other at their base, and between these arises the flower stalk, which grows near two feet high, having one or two narrow leaves embracing it like a sheath. The stalk is terminated by five or six purple flowers, standing above each other at some distance, and ranged on one side of the stalk; each of these has a sheath which covers the flower-bud before it expands, but splits open length-ways when the flowers blow, and afterwards shrivels up to a dry skin, which remains about the seed-vessel till the seeds are ripe, which is in the beginning of August. The flowers come out in the latter end of May, or in June. Some of the flowers are white, and others flesh-coloured.

Corn-marigold (Chrysanthemum). Mr. Miller enumerates * twelve species of this plant, among

* *Gardener's Dict.* Art. CHRYSANTHEMUM.

which

which he properly distinguishes as weeds, that with leaves which embrace the stalks, the upper being jagged, and the lower indented like a saw*; and that which C. Bauhin names the greater wild daisy with a leafy stalk†. The former of these is the common corn-marigold, too frequent among corn, and in the borders of corn-fields. The latter, which delights more in moist pastures, of which few are without it in this country, rises with stalks near two feet high, garnished with oblong indented leaves, which embrace the stalks with their base. Each of these stalks is terminated by one white flower, shaped like that of the daisy, but four times as large. It flowers in June. The corn-marigold has a perennial woody root, which strikes deep, requires a considerable quantity of food, and must therefore be a great enemy to corn. Considerable pains must be taken before this weed can be extirpated, as it is highly probable that, besides multiplying by its roots, its seed will grow if plowed in, as that of the garden marigold will do when dug in. Deep and repeated hoeings are therefore necessary, before it can run to seed.

Couch, Couch-grass, Quick-grass, Knot-grass or Dog-grass ‡, as it is frequently called (*Gramen*), is one of the worst of weeds among corn, and one of the most difficult to extirpate in arable land; every joint of its long creeping roots being capable of soon producing a new plant, after those roots have been broken by the plough. The

* *Chrysanthemum foliis amplexi caulibus, supernè lacinatis, infernè dentato-ferratis*; likewise called the *Chrysanthemum, segetum*, or corn-marigold.

† *Bellis sylvestris caule folioso major*.

‡ This is Ray's *Gramen spicâ triticeâ repens vulgare, caninum dictum*, common creeping grass with a spike like wheat, called dog-grass; and Linneus's *Triticum calycibus subulatis trifloris acuminatis*, wheat with an awl-shaped pointed empalement including three flowers.

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usual method of destroying it is by laying the land fallow in summer, and frequently harrowing it well over to draw out the roots, every piece of which should then be burnt, for the reason before assigned. Where this is carefully done, the ground may be so well cleansed in one summer, that the remaining roots will not do any great injury to the next crop: but the best way is to sow the land in which this weed prevails, with such things as require the horse-hoeing culture. The blade of this grass is so rough, that cattle will not feed upon it when green.

Devil's-bit (*Scabiosa* †) is found in many fields of corn, but more frequently in meadows. It has a strong, thick, fibrous, perennial root, which runs deep into the ground, and sends out several branching stalks, which rise near three feet high. The lower leaves are sometimes almost entire, and at others they are cut into many segments almost to the mid-rib: they are seven or eight inches long, and from three to four broad in the middle, hairy, and sit close to the root. The stalks are covered with stiff prickly hairs, and garnished with smaller leaves at each joint. The flowers, which are of a pale purple colour, and have a faint odour, appear in June, upon naked foot-stalks at the end of the branches which decay to the root every autumn.

The *Dock* (*Rumex*), of which there are several sorts, is so remarkable by it's large leaves, that he must be a very slovenly farmer who suffers it to grow to any size. If he is at all careful of his land, he will pluck or cut it up as fast as it appears; which he may easily do, it being of the tap or carrot rooted kind.

† So called from *Scabits*, a Scab, which this plant is said to heal.

Dyer's-weed, or *wild woad*, by some called *weld*, and *bastard-rocket*, (*Reseda*), is a troublesome plant when considered as a weed. Its root is long, white, and somewhat woody; its leaves are unequally winged, and entire; its stalks, which are channelled, and garnished with smaller leaves, rise a foot and a half high, and are terminated by a long loose spike of pale yellow flowers, which are succeeded by a triangular seed vessel filled with black seeds. This is a biennial plant, which flowers and seeds the second year, and perishes soon after. It is observed to make the milk of the cows that feed on it bitter, and to communicate the same taste to the butter and cheese made of that milk. Of this species is the woad very profitably cultivated for dying, and which will be spoken of hereafter.

Ground-ivy (*Glechoma*) is one of those trailing plants which strike out roots from the joints of their stalks: but as it generally grows under hedges and upon the sides of banks, it cannot be said to do any injury adequate to the salutary effects of its medicinal qualities.

May-weed, or *Morgan*, a wild species of Chamomile * (*Anthemis*), is a trailing perennial plant, which puts out roots from its branches, as they lie on the ground. By this means, and by scattering its seeds long before corn is ripe, it spreads and multiplies greatly. It flowers in May, and is therefore called May-weed: though some have improperly given this name to the *Cotula fetida*†, which seldom blossoms till late in June. The means

* It is Linnæus's *Anthemis receptaculis conicis, paleis setaceis, seminibus coronato-marginatis*, Chamomile with a conical receptacle of bristly chaff, and bordered seeds; which is C. Bauhin's *Chamæmelum inodorum*, Wild Chamomile or May-weed.

† Linnæus's *Anthemis receptaculis conicis, paleis setaceis, seminibus nudis*, Chamomile with a conical receptacle, bristly

of extirpating it are, summer fallows, repeated good harrowing, and burning the collected roots, as before directed in similar cases, or, which will be found still more effectual, the frequent hoeings practised in the new husbandry. What escapes these clearings, should be very carefully pulled up by hand; for the common weeding hook will not go deep enough to take out the whole of the long slender-tap root of this plant, of which every remaining bit that has a knot in it will produce new shoots. Nor ought the farmer to regret this small additional expence, to get rid of one of the most fatal enemies his corn can have. Mr. Lisle assures us ^a that as good a crop of wheat as one would wish to see all the winter time, was, to his knowledge, so destroyed by the coming up of May-weeds and poppies in the spring and summer, that it did not at last yield so much as the seed.

Mugwort (*Artemisia*) is a most troublesome weed, for it's roots creep far under the surface of the ground, so as soon to overspread a large space, if they are not stopped; and it's seeds, being light, and easily carried to a distance by the wind, will produce numbers of new plants the next Spring. It has plain cut leaves, ending in many parts, woolly underneath, and single spikes of pale yellow oval flowers, which blow in June.

The *moxa*, so famous in the Eastern countries, for curing the gout, by burning the part affected, is the down on the under part of the leaves of a species of mugwort, supposed to be different from our common sort[†]. But Mr. Miller judges, from

chaff, and naked seeds; and C. Bauhin's *Chamæmelum fatidum*, stinking May-weed.

^a *Observations in Husbandry*, Vol. II. p. 305.

[†] Which is Linnæus's *Artemisia foliis pinnatifidis plantis incisiss subtus tomentosis, racemis simplicibus, floribus ovatis, radio*

from the dried samples of it brought to England, and shewn to him, that the only difference is in the size of the plant, the foreign being much smaller than ours: to which he adds, that, with respect to the gout, he supposes the soft down of this last, or indeed of any other plant, will answer the purpose full as well^b.

Mullein (*Verbascum*) is a biennial plant, which perishes soon after it has perfected it's seeds. The lower leaves of the common sort, which is the species here spoken of as a weed, though it be that which is used in medicine, spread on the ground, are nine or ten inches long, and six broad, very woolly, of a yellowish white colour, and have scarce any footstalks*. The stem rises four or five feet high, and the upper part of it is garnished with yellow flowers, which sit very close, and form a long thick spike. These flowers have an agreeable odour. They appear in July, and the seeds ripen in autumn. This plant is most common by the sides of high-ways, and on banks: but if it once gets into fields in a warm exposure, and is suffered to seed there, it will soon over-run the whole ground. It may easily be destroyed, by cutting off the stem when it is in flower.

Nettle (*Urtica*). The larger sort of this well known stinging weed is perennial, and the smaller sort is annual. Tolerably good cordage has been made of the threads or filaments of this plant, treated as hemp. They are strong and tough, and

dio quinquefolio: *Sp. Plant.* 348. Mugwort with plain cut leaves, ending in many parts, woolly underneath, with single spikes of flowers, which are oval, and the rays composed of five florets. It is also C. Bauhin's *Artemisia vulgaris major*, Common great Mugwort.

^b *Gardener's Dict.* ART. ARTEMISIA.

* This is Bauhin's *Verbascum mas latifolium luteum*, Great white Mullein, Hig-taper, or Cows-lungwort.

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certainly afford great room for farther improvements of that kind, well deserving the attention of the curious, who direct their inquiries to objects of public utility. Cutting it up by the root, before it can seed, is the way to destroy it.

Silver weed or *wild Tansey* (*Potentilla*) is a species of cinquefoil* which grows naturally upon cold stiff land in most parts of England, and is a sure mark of the sterility of the soil. It's stalks spread upon the ground, and send out roots from their joints; by which means, and by the frequent shedding of it's seeds, for it flowers during the whole summer, it soon over-runs, and fills the land to a great distance. The leaves of this plant are composed of several lobes or wings, which are generally placed along the mid-rib, and terminated by an odd one: they are jagged at their edges, and are of a silvery colour, especially on their under side. The way to destroy this kind of growth has been already pointed out. Mr. Ray says, that the root of wild tansey, which is somewhat of the parsnep kind, is good to eat, and that hogs are very fond of it.

Thistle (*Carduus*). Wherever this grows naturally, it is a sure sign that the land is strong: but at the same time it is a great annoyance to every plant intended to be cultivated. This weed is too well known to need any description. The best way to destroy it is to cut it up by the roots before it's seeding time, which is in the autumn; for cutting of it too young, will only make it branch the more: or, which Mr. Lisle prefers^a, to pluck the thistles up by hand, when the ground is reasonably moist, before they are grown to the size at which

* It is Tournefort's *Pentaphylloides argenteum alatum*, seu *Potentilla*. *Inst.* 298.

^a *Observations in Husbandry*, Vol. II. p. 293.

they

they are usually cut. They may then be easily drawn up with their roots, by the thumb and two fingers; and the weeder may guard against their prickles by putting on a glove, or false fingers, made of hard leather. Chalking of land is a good way to destroy this very noxious growth: but thorough tillage, summer fallows, and repeated good harrowings, are the most effectual of all.

By an excellent regulation in France, a farmer may sue his neighbour who neglects to thistle his land at the proper seasons, or may employ people to do it at the other's expence^b. And it were to be wished, that a similar law was enacted here, to prevent the wide-spreading mischiefs occasioned by the seeding of this pernicious weed; among which may be reckoned, besides it's choaking the young corn, that if wheat, in particular, be not well thistled, the reapers take up the grips so tenderly, lest they should prick themselves, that, by their loose handling of them, they sometimes leave upon the ground corn enough to sow the whole field.

Of the weeds propagated by their seeds, which ripen either before or with the corn, and which sow themselves, or are gathered with it, the following are most to be feared.

Chickweed (the common), which Botanists distinguish by the name of *Alsine*, though but an annual plant, will soon become very troublesome, if it be suffered to stand till it sheds it's seeds, which Mr. Lisle thinks ^k it will do several times in the year: for he observed, on the 23d of October, a great deal of this weed, the branches of which carried many buds of blossoms, many flowers full blown, and many pods with white seeds almost

^b *Maison Rustique*, Tom. I. p. 640.

^k *Observations in Husbandry*, Vol. II. p. 312.

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ripe; so that it's increase can be the less guarded against by any sort of husbandry in the common way. The repeated horse-hoeings in the new husbandry, must here be attended with great advantage; and, at all events, particular care should be taken, to prevent the seeding of this plant upon dunghills, where it is too often suffered to grow un-noticed, and undisturbed: for it's seeds scattered there, and intermixed with the dung, will soon give birth to a multitude of weeds in the land upon which it is spread; unless it be kept, as indeed all dung used for manure ought to be, till it is thoroughly rotted, and the seeds have lost their vegetative power.

Charlock (Raphanus), the young plants of which are so very like these of young turneps, as not easily to be distinguished, but by the taste; the charlock being hot and bitter, and the turnep mild. Farmers should therefore be very careful in the weeding of their turneps, lest they rear or pluck them up indiscriminately. Mr. Lisle observes^a, that cold wet lands are always more subject to charlock than white land; because, says he, the charlock seed, being very oily, resists putrefaction, and is not easily opened or penetrated by moisture; whereas white and light earth is soon dry after rain, and the water does not continue long enough on it to make such seed germinate so effectually as in the other. By an experiment which he made, of sowing charlock seed and turnep seed at the same time, he found that the turneps will appear in three days, and the charlock not in less than ten. This hint may be very useful to the husbandman. Mr. Mortimer, after remarking^o that both the white and the yellow charlock, which he calls carlic, are very prejudicial to corn, and that some lands are very

^a *Observations in Husbandry, Vol. II. p. 297.*

^o *Art of Husbandry, Vol. I. p. 311.*

subject to it, especially if manured with cow-dung alone, which, he thinks, increases it more than any other manure, unless it be mixed with horse-dung, or some other hot manure; mentions his being told, that a person who had vast quantities of this weed in a field of barley, mowed the whole when the charlock was in flower and ready to seed, which is commonly about the middle of May, as low as he could, without taking off more than just the tops of the blades of the barley, and that this killed the charlock, and gave the corn an opportunity to get above it, in such a manner, that he had four quarters of barley on an acre. He adds, that where a fallow is full of charlock, it will be right to turn in sheep, for that they will eat it very readily: and Mr. von Döhren, of Hamburgh, informs me, that it is common in Holstein to give charlock to horses, either green, dried, or its seeds mixed with oats; that those cattle are fond of it, and that it is found to be a very heartening food.

Cow-wheat, (*Melampyrum*), by some called *Fox-tail**, is a pernicious weed in many countries. Its seed is somewhat like wheat, and, according to Clusius, spoils the meal with which it is ground, by giving it a dark colour and a bitter taste: though Mr. Ray says he could never perceive any disagreeable relish in the bread with which it was mixed. Mr. Miller says † it is a delicious food for cattle, particularly for fattening of oxen and cows, and that it may be worth while to cultivate it for this purpose. Its seeds seldom grow the first year, unless they chance to be sown, or to sow themselves, in the autumn, soon after they are ripe.

* Which is C. Bauhin's *Melampyrum purpurascens coma*, or Cow-wheat with purplish tops.

† Gardener's Dict. Art. MELAMPYRUM.

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Devil in a bush, or Fennel-flower (Nigella), is a troublesome weed among the corn in Italy, France, and Germany, where it abounds much more than in this country. It rises with slender stalks, near a foot high, which sometimes branch out at the bottom, and sometimes are single, garnished with a few very fine cut leaves, somewhat like those of dill. It's flower is generally blue, and it's seeds are rough and black. This, together with their being nearly of the same size as the grains of wheat, renders it difficult to separate them from the good corn, when they have been gathered with it; and when ground with it, they blacken the meal. As this plant is annual, it may be extirpated by rooting it out before it can seed, which commonly is in August.

Fenugreek (Trigonella), though not common in the fields in England, abounds so much in some places, particularly in warm countries, as to be a troublesome weed. It is an annual plant, which rises with a hollow branching herbaceous stalk, a foot and a half high, garnished with trifoliate leaves placed alternately. These leaves are indented on their edges, and have broad furrowed footstalks. The flowers, which are white, and of the butterfly kind, as botanists term it, come out singly at each joint from the wings of the stalk, to which they sit very close. These are succeeded by long compressed pods, shaped somewhat like a broad-sword, ending in long joints, with a broad membrane on one edge, and filled with square yellow seeds, indented on one side like a kidney. The whole plant has a very strong odour, and it's seeds ripen in August, if the summer has been warm. The species of this plant which C. Bauhin distinguishes by the appellation of *Fenum Græcum sativum*, is cultivated in the South of France, and in Germany, from whence such quantities

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tities of the seeds are imported here annually, that Mr. Miller thinks it might be worth while to try to propagate it in this country: to which end he gives pretty ample directions in his Gardener's dictionary^p. These seeds give a bad taste to the corn they are ground with.

The sort of *Groundsel* (*Erigeron*) which is looked upon as a weed, is a small annual plant, seldom visible during more than two or three months in the year. It comes to maturity in about a month, sows itself, and dies; so that like all other weeds of this class, whose seeds ripen either before or with the corn, and which sow themselves, it is easily extirpated by preventing it's seeding.

Hare's foot Trefoil (*Trifolium arvense humile spicatum, sive lagopus*) abounds most in dry gravelly land, and is a sure indication of the sterility of the soil; for it is rarely seen upon good ground. It is an annual plant, whose root decays soon after it has perfected it's seed; and so coarse, that cattle seldom eat it. Mr. Lisle observed some ridges so pestered with this bastard kind of clover, that he thought it as bad a weed as any he had seen that year^q. Another species of Trefoil which is apt to infest arable land in many parts of England is distinguished by the name of *Strawberry Trefoil**, and has trailing stalks which put out roots at their joints. The leaves stand upon long slender foot-stalks; the lobes are roundish, and sawed on their edges; the flowers are collected in roundish heads, standing upon slender foot-stalks, which rise from the wings of the stalks; and these have bladder empalements which terminate in two teeth. When they lie on the ground, their globular heads, hav-

^p Art. TRIGONELLA. ^q Vol. II. p. 313.

* This is the *Trifolium capitulis subrotundis, calycibus inflatis bidentatis reflexis, caulibus repentibus*. Hort. Cliff. 373. and C. Bauhin's *Trifolium fragiferum friscum*, or Strawberry Trefoil.

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ing a little blush of red on their upper side towards the sun, and the other part being white, look not unlike Strawberries; and from thence this kind derives it's particular name †.

Melilot (*Melilotus*) commonly used in medicine, is of the trefoil kind ‡, and grows in such abundance among the corn in many parts of England, particularly in Cambridgeshire, as to be a most troublesome weed; for it is hardly possible to separate it from the corn in reaping, so that they are housed together, and the seeds of the melilot, which ripen about the same time as the corn, are threshed out with it, after which, they being likewise heavy, it is very difficult to separate them. If but a few of these seeds are ground with the corn, they will spoil the flower; for the bread, or whatever else is made with it, will have a strong taste and smell, like melilot plaster. The roots of this plant are strong and woody, and from them spring out several stalks which rise from two to four feet high, according to the goodness of the land. These stalks branch out, and are garnished with trifoliate leaves, having oval sawed lobes of a deep green colour. The flowers are produced in long slender spikes, which spring from the wings of the stalks. They are of a bright yellow, shaped like the other butterfly flowers, and are succeeded by naked seeds which ripen in August.

Spurrey (*Spergula*) is a common weed in many parts of England. It seldom rises above six inches high, flowers in the beginning of July, ripens it's seeds in August, and is an annual plant. The way to extirpate it is consequently by summer fallows,

† MILLER'S *Gardener's Dict.* ART. TRIFOLIUM.

‡ It is the *Trifolium leguminibus racemosis nudis dispermis, caule erecto.* Hort. Cliff. 376. Trefoil with long naked bunches of pods containing two seeds, and an erect stalk; which is C. Bauhin's *Melilotus officinarum Germaniæ*, common Melilot.

and cutting it off before it can scatter it's seeds, which are very small. Two species of this plant* are cultivated in Holland and Flanders, for the winter food of cattle, when there is a scarcity of grass. It is said to enrich the milk of cows so as to make it afford excellent butter; and the mutton fed on it is frequently preferred to that which has been fed on turneps. Hens too eat this herb greedily, and it is commonly thought to make them lay an extraordinary number of eggs: From the lowness of it's growth, this plant cannot afford a very great quantity of fodder: but as it will grow on the poorest sand, where no other grass will thrive so well, it may be cultivated to good advantage in many places; and by feeding it off the ground, the dung of the cattle will improve the land. The people in the Low-Countries commonly sow it twice a year; the first time in April or May, to be in flower in June or July; and the second time after rye-harvest, to serve their cattle in November and December. The usual allowance with them is about twelve pounds of seed to an acre of land.

Wild-garlick, Crow-garlick, or Cow-garlick, as some call it (*Cepa*), will do great damage to corn in dry sandy grounds, but will not grow in clays, according to Mr. Lisle, who mentions^a a farmer in some of whose fields it grew in such abundance, that his wheat tasted strong of it, and was thereby damaged from six-pence to a shilling in the bushel.

* Namely the *Spergula foliis verticillatis, floribus decandris*, Hort. Cliff. 173. Spurrey with leaves in whorls, and flowers with ten stamina, which is C. Bauhin's *Alfine Spergula dicta major*, Greater Chickweed called Spurrey; and Linnæus's *Spergula foliis verticillatis, floribus pentandris*, Spurrey with whorled leaves, and flowers with five stamina; or Tournefort's *Alfine spergulæ facie minima seminibus emarginatis*, The least Chickweed with the appearance of Spurrey, having bordered seeds.

^a *Observation in Husbandry, Vol. II. p. 313.*

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Wild-oats are difficult to be extirpated where they have once taken possession; for, ripening before harvest, and scattering their seed around them, they will remain in the ground till it is plowed up again, though it be for a whole year, some say four or five years, and will then come up with the corn. The surest way to destroy them, is, to lay the ground down with clover, and to mow the oats and clover together before the oats are ripe. Their roots will not shoot out again.

Wild-poppy, or *red-weed* (*Papaver erraticum*), common in almost all arable lands, but most so in the lightest and consequently poorest, is an annual, which sometimes multiplies so prodigiously by it's seeds, that it choaks the wheat among which it grows. The sorts most frequent in our corn fields are, 1. The common red poppy, which rises about a foot and an half high, with several rough branching stalks garnished with hairy leaves five or six inches long, deeply jagged almost to the mid-rib, and which flowers in June: 2. A smaller kind with leaves cut into much finer segments, slender stalks, little more than a foot high, not so branching as the former, and smaller flowers, of a deeper red, which likewise appear in June: and 3, a smaller sort than either of the former, with copper coloured flowers, which appear in May. The flowers of all these are succeeded by oblong prickly heads, filled with small black seeds, which sow themselves if they are suffered to stand.

Wild-vetches (*Vicia segetum*) are great enemies to corn wherever they prevail, and especially if it happens to be lodged: for they then soon get above it, keep it down, and thereby contribute greatly to it's rotting. Too much care cannot be taken to extirpate them, by preventing their seeding.

Upon

Upon the whole, it may be looked upon as a general rule, that sowing of clean seed, and laying the ground down to grass, will at length overcome all sorts of weeds; and the more in heart the land is laid down to grass, the thicker the grass, or clover, will grow, and the better effect it will have.

S E C T. II.

Of Quadrupeds, Birds, Vermin, and Insects; as enemies to Corn.

AMONG the quadrupeds, birds, and vermin, which do mischief to the standing corn, most writers upon Agriculture reckon hares and rabbits. Mr. Lisle observed particularly in a field of barley, so many full-grown ears lying withered along a track in the field, that, thinking it a great spoil, and desirous to know what had occasioned it, he took them up, and found that the hares had bitten the straws off at the ground, to make themselves a more convenient passage^a. Rabbits frequently do much greater hurt: so that the farmer can hardly have a corn-field worse situated, than in the neighbourhood of a warren. In hard winters especially, they will go a great way to feed upon his green corn.

Moles are very pernicious enemies to all husbandry, by loosening of the earth, and destroying the roots of corn, grass, and other vegetables.

The common way of destroying them, particularly in the southern parts of England, is by traps which fall on them, and strike sharp tines or teeth through them. But a better instrument for this

^a *Observations in Husbandry, Vol. II. p. 390.*

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purpose is thus described by Mr. Mortimer^b, who has copied it from Mr. Worlidge^c.

Take a small board, about three inches and a half broad, and five inches long: on one side thereof raise two small round hoops or arches, one at each end, like the two hoops or bails of a carrier's waggon, capacious enough for a mole to creep through easily: in the middle of the board make a hole about the bigness of a goose-quill, and have in readiness to put into it a stick about two inches and a half long, fitted at one end to the hole, and a little forked at the other. Cut also a hazel or other stick, about a yard, or a yard and a half long, which will rise with pretty strong elasticity, when it is stuck into the ground; and to the end of this stick fasten a very strong noose of horse-hair, made so as to slip easily. Have likewise in readiness four small hooked sticks: then go to the furrow or passage of the mole, and after you have opened it, fit in the little board with the bended hoops downward, so that when the mole passes that way, it may go directly through the two semi-circular hoops. But before you fix the board in this manner, put the hair string through the hole in the middle of it; place the noose in a circular form, so as to make it answer to the two hoops; put the small stick before mentioned gently into the hole in the middle of the board, so as just to stop the knot of the hair spring, without entering so far as absolutely to tighten it. Then fasten the board down with four hooked sticks, and cover it with earth. When the mole, passing in it's furrow, comes into this trap, it will displace the small stick that hangs perpendicularly downward, the knot will then be drawn through the

^b *Art of Husbandry*, Vol. I. p. 315.

^c *Systema Agriculturae*, p. 216.

hole, and the noose, instantly streightened by the rising of the end of the hazel stick to which it is fastened, which will catch the mole round the neck.

Others, watching their motions in the morning and evening, which are their usual times of stirring, dig them out in a moment with a spaddle: and about March, which is their time of breeding, numbers of their young ones may be destroyed by turning up their nests, which are generally in the greatest hills; and the old ones who come to seek their young will presently be taken.

Some commend the pot-trap, which is a deep earthen vessel set in the ground with the brim even with the bottom of the mole-tracks. The season for using this is when the moles couple, which is about the beginning of March, or perhaps somewhat earlier.

Mr. Worlidge says ^d, they may be driven from gardens, meadows, and other places where one would not choose to dig, by fuming their holes with brimstone, garlick, or other unfavoury things; and that the putting a dead mole into a common haunt, will make them absolutely forsake it: to which Mr. Mortimer adds ^e, but only upon report, that white hellebore and the roots of palma-christi, dried, powdered, and sifted through a fine sieve, then mixed with barley-meal and eggs, and worked into a paste with wine and milk, will kill them, if laid in little pellets under their hills.

Almost every countryman is experimentally sensible of the great injuries done by rats and mice, not only to the corn laid up in stacks, barns, and granaries, but also to that in the field, where these vermin, and particularly the field mice, multiply to such a degree in some places, that it is hardly possible to destroy them. The means of

^d *Systema Agriculturae*, p. 217.

^e *Art of Husbandry*, Vol. I. p. 317.

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hindering them from preying upon corn in the stack, have been already pointed out *; and the means of guarding against them in barns and granaries will be noticed hereafter.

As to birds, it is generally allowed, that rooks and sparrows destroy much more corn than pigeons; though some complain grievously even of these last. Rooks are undoubtedly great annoyances to it, at seed-time, by pulling it up whilst it is young, and by feeding on it also at harvest. According to Mr. Lisle^a, they will not pull up the spring or lent-corn till seed time is over, and there is not grain for them; nor do they much care for peas in the grain, or for barley, so long as they can come at oats: for the oat stripped of it's husk is much sweeter and tenderer than barley: but when it comes up into blade, they will fall most on barley, which is sowed later, is a fuller bodied grain, and has more flour left in it, than the oat: When they attack barley in the ear, it generally is in light hollow ground, where the corn is loose at the root. "If peas were sowed late, continues he, "they would doubtless fall on their blade, and "pull them up, rather than other corn, because "of the bulk of their grain, in which there is "more flour to be found unexhausted: and I do "remember, they fell on goar-vetches which were "sowed in May, with such voraciousness, that it "was very hard to secure half of them. In some "grounds, which they take to, one may gather a "handful of blades pulled up by them in the "compass of a yard." They do most harm when the snow is first going off from the green wheat, towards the end of winter: for having been pinch-

* See Vol. I. p. 464.

^a *Observations in Husbandry*, Vol. II. p. 393.

ed for food during that season, they then greedily pluck up the young plants, in order to come at the remainder of the seeds still adhering to their roots; and are greatly assisted in this by the loose state of the earth at that time.

Among the many contrivances to frighten them away, such as feathers stuck up, the limbs of rooks scattered about the ground, dead rooks hung on sticks, the gun, a boy to halloo and throw his hat, or to toss a dead rook up in the air, Mr. Tull says he found this last to be the most effectual. They will immediately quit their usual places of abode; if the earth is turned up around the trees, in which they have built their nests, and will not return to them 'till the grass is grown again; as was lately experienced in the repairing of Fountain-court in the Temple: and Mr. Lisle assures us^a, that the taking down of their nests, with their young ones in them, and burning under the trees they were built in, will effectually make all the old ones desert that place. However, it has been doubted, and perhaps with reason, whether they do not, upon the whole, compensate pretty fully, for the mischief they do to corn, by destroying vast quantities of grubs, worms, and other pernicious insects in the spring: as crows are also of service in the neighbourhood of populous towns, by devouring a great deal of carrion.

It is a common proverbial saying of the countrymen; that at whatsoever farm a colony of rooks plant themselves, and make a rookery, it is a sign of prosperity to the occupier of that land; and that, on the contrary, their deserting it, betides misfortunes and poverty: for both which remarks, Mr. Lisle accounts very rationally, by observing^b, that where a man is a good husbandman to his

^a *Ibid.* p. 396.

^b *Ibid.* p. 397.

land, and improves it, the worms, which are a great food to these creatures, especially at certain times of the year, multiply, and grow to a much greater bulk and fatness, than in a poor neglected soil; the strength of land being as discernable by the large size of worms, as from the growth of plants; and that the grubs or maggots of the beetle kind in particular, on which the rooks feed greatly, as is apparent from their following the plough, in order to pick them up, not only grow fattest and largest in rich well tilled ground; but that the beetles themselves, while in their state of flies, always choose to lay their eggs in such land as will best nourish and provide for their young. The contrary to this soon happens under a bad husbandman.

Sparrows, though but small, are a very numerous generation of corn-eaters, and make sad havock among it at harvest-time, especially near hedges and villages. Bearded-wheat, barley and rye, are less their prey than any other grain: a circumstance which may be worth the farmer's attending to in places where his land lies near to their usual haunts; for it is better to have a full crop, even of rye, than to have half a crop of wheat eaten by them, after it has been raised with great care. As they are easily allured to any particular spot baited for this purpose, especially in hard weather in the winter, and in summer before the corn is ready for them, at both which times their food is scarce abroad, and they then flock to stacks and barns; dozens of them may be taken at a time with the large folding sparrow net.

M. Duhamel is a pretty strong advocate for partridges and pigeons, the former of which, only nip off the tips of the young blades of corn, without scratching or digging for the seeds, and consequently cannot do any great hurt, unless they

they are extremely numerous; and the latter, he thinks^b, neither feed upon the green corn, nor have bills strong enough to search for it's seeds in the earth; but only pick up the grains that are not covered, which would infallibly become the prey of other animals, or be dried up by the sun. "From the time of the sprouting of the corn, says he, pigeons live chiefly upon the seeds of wild uncultivated plants, and therefore lessen considerably the quantity of weeds that would otherwise spring up; as will appear from a just estimate of the quantity of grain necessary to feed all the pigeons of a well stocked dove-house." But Mr. Worlidge and Mr. Lisle allege facts in support of the contrary opinion. The latter relates^c, that a farmer in his neighbourhood assured him he had known an acre sowed with peas, and rain coming on so that they could not be harrowed in, every pea was fetched away in half a day's time by pigeons: and the former says^d, "It is to be observed, that where the flight of pigeons falls, there they fill themselves and away, and return again where they first rose, and so proceed over a whole piece of ground, if they like it. Although you cannot perceive any grain above the ground, they know how to find it. I have seen them lie so much upon a piece of about two or three acres sown with peas, that they devoured at least three parts in four of the seed, which, I am sure, could not be all above the surface of the ground. That their smelling is their principal director, I have observed; having sown a small plat of peas in my garden, near a pigeon-house, and covered

^b *Elements d'Agriculture, Liv. II. C. 7. Art. 2.*

^c *Observations in Husbandry, Vol. II. p. 392.*

^d *Systema Agriculturae, p. 219.*

“ them so well that not a pea appeared above
 “ ground. In a few days, a parcel of pigeons
 “ were hard at work in discovering this hidden
 “ treasure; and in a few days more I had not
 “ above two or three peas left out of about two
 “ quarts that were planted; for what they could
 “ not find before, they found when the buds ap-
 “ peared, notwithstanding they were hoed in, and
 “ well covered. Their smelling alone directed
 “ them, as I supposed, because they followed the
 “ ranges exactly. The injury they do at harvest
 “ to the peas, vetches, &c. is such that we may
 “ rank them among the greatest enemies the poor
 “ husbandman meets withal; and the greater,
 “ because he may not erect a pigeon-house, where-
 “ by to have a share in his own spoils; none but the
 “ rich being allowed this privilege, and so severe
 “ a law being also made to protect these winged
 “ thieves, that a man cannot encounter them even
 “ in defence of his own property. You have
 “ therefore no remedy against them, but to af-
 “ fright them away by noises, or such like. You
 “ may, indeed, shoot at them; but you must not
 “ kill them; or you may, if you can, take them
 “ in a net, cut off their tails, and let them go;
 “ by which means you will impound them; for
 “ when they are in their houses, they cannot bolt
 “ or fly out of the tops of them, but by the
 “ strength of their tails, after the thus weakening
 “ of which, they remain prisoners at home.”

Mr. Worlidge's impounding the pigeons re-
 minds me of a humorous story of a gentleman
 who, upon a neighbouring farmer's complaining
 to him, that his pigeons were a great nuisance to
 his land, and did sad mischief to his corn, replied
 jokingly, pound them, if you catch them trespass-
 ing. The farmer, improving the hint, steeped a
 parcel of peas in an infusion of *Coculus Indicus*, or
 some

some other intoxicating drug, and strewed them upon his ground. The pigeons soon swallowed them, and soon remained motionless on the field; upon which the farmer threw a net over them, inclosed them in it, and carried them to an empty barn, from whence he sent the gentleman word, that he had followed his directions about the pounding of his pigeons, and desired him to come and release them.

Mr. Mortimer recommends^e as a means of hindering birds from eating of new-sown corn, to sprinkle lime or soot upon it: and he rightly observes, with Mr. Worlidge^f, that moist and warm lands, which are usually the most fertile, are the most subject to vermin in general.

Ants and pismires, which are reckoned among the pests of the field in hot countries, such as Italy, Spain, and the West-Indies, do much less injury here to corn-fields, than to pasture-lands and gardens; under which last heads the means of destroying them will therefore be spoken of: as will also, for the same reasons, what relates to the guarding against snails and slugs, two species of vermin, which, especially in wet years, frequently kill a great deal of corn, by eating it off at the roots.

The grub or large maggot, which some call the rook-worm, because rooks are particularly fond of it, and which often does considerable injury to corn, by under-mining it, and preying upon it's roots, is that which produces the beetle, and is best extirpated by good and frequent plowing. This, let the land be ever so much infested with that insect, will clear the ground of it, at least for some years.

^e *Art of Husbandry*, Vol. I. p. 322.

^f *Systema Agriculturae*, p. 221.

Worms are very prejudicial to land, by eating the roots both of corn and grafs, especially when the corn begins first to shoot. Mr. Worlidge says^g, that a strong lie made of the ashes or fixed salts of any vegetable, will not only destroy them, but prove at the same time an extraordinary enricher of the ground: and Mr. Mortimer, after confirming this, adds^h, that he believes sea-water would be a very great improvement of such lands near the sea, as are troubled with them. He once sowed foot upon a piece of very rank clay which was greatly infested with worms, and thereby killed several bushels of them: but he likewise tried foot upon other clayey lands, and upon other soils, without finding the same effect. Whether this was owing to the difference of the soil, to the season in which he did it, or to the land's having been footed before, he could never determine. Some commend chalk and lime, as very powerful to destroy them. The winter fallowing of land in a wet time, when the worms come up to the surface of the ground, is also very good to kill them: especially if a few nails with sharp heads are driven into the bottom and sides of the plough, which will then cut them to pieces. Water in which walnut leaves have been soaked for a fortnight or three weeks, till it is very bitter, will kill them; but this cannot be practised in corn fields, as it may in gardens: though it may, perhaps, be worth while to try what effect steeping of the seed corn in a liquor of this kind will have, not only as a preservative against worms and other insects; but even, perchance, against the smut, or other distempers.

Hurtful as many of the above enemies to corn frequently are, they often do it still less injury than

^g *Ibid.*

^h *Art of Husbandry, Vol. I. p. 323.*

several small insects, some of which are so very minute as scarcely to be noticed by the farmer.

Among others, a small kind of worm gets into the roots, chiefly of oats, and, working upwards destroys all the inside of the plant, which perishes, soon after. M. Duhamel suspects it to have been an insect of this kind that destroyed vast quantities of wheat in the neighbourhood of Geneva, and of which M. de Chateaufvieux sent him the following account. "Out wheat, says that illustrious husbandmanⁱ, in the Month of May 1755, sustained a loss which even that cultivated according to the new husbandry did not escape. We found in it many little white worms, which afterwards became of a chesnut colour. They post themselves between the blades, and eat the stems. They are usually found between the first joint and the roots. Every stalk which they attacked, grew no more, but became yellow, and withered. The same misfortune beset us in the year 1732. These insects appeared about the middle of May, and made such havock that the crop was almost destroyed."

Mr. Lisle mentions^a that, on the 13th and 14th of June, in pulling up wheat in ear, and sowing thistles, he observed among the upper part of the roots of most of these plants, knots or clusters of grass-lice, or green locusts, as he calls them, which appeared whitish when they were but just come to their shape, and as yet under ground: and among most of these clusters he observed a fly at her incubation, very turgid of a whitish matter; she being then blowing these insects. Her wings were black, and he thought her plainly the same

ⁱ DUHAMEL, *Traité de la Culture des Terres*, Tom. IV. p. 316. and *Eléments d'Agriculture*, Tom. I. p. 299.

^a *Observations in Husbandry*, Vol. II. p. 402.

as the locust, excepting that it had wings. He did not find more than one fly at any one root.

We too often find, in our kitchen-gardens, a sort of vermin called vine-fretters. They fix upon the roots of leguminous plants, which afterwards gradually turn yellow, and die. M. Tillet says he has observed the same insect in the roots of wheat.

The cuckow-spit, or spring-forth, as it is commonly termed, lodges itself principally in the joints of plants, seldom appears before the latter end of May, and is most common when rain has fallen after a series of dry weather. M. Poupart, in his account of this little creature ^b, says, that as soon as it is out of it's egg, it goes to a plant, which it touches with it's fundament, and fastens there a white drop of liquor full of air; that it drops a second near the first, then a third, and so on till it covers itself all over with a scum or froth, which keeps it from the heat of the sun, or spiders that would suck it. But Mr. Lisle ^c takes this liquid to be nothing but the nightly dew, which falls on the fork or joint of the plant, where the little insect works it into froth with its proboscis, as with a bellows.

M. Duhamel has frequently noticed, and made drawings of, a species of small insects, some of a bright red, and others black, which are found in great numbers in the ears of wheat. He suspected that they fed on a sweetish juice which is in the ear whilst green: and M. Tillet, who was immediately of opinion that they might do considerable damage to the grain, followed them very assiduously in all their metamorphoses, of which he has given a full account in the memoirs that gained

^b *Journal des Sçavans pour le mois d'Avril, 1707.*

^c *Voi supra.*

the prize of the Academy of Bordeaux for the year 1755.

The inhabitants of a considerable part of the province of Angoumois have, for thirty years past, sustained an hitherto irreparable loss, by an insect which begins to devour their corn even in the ear, before it is reaped. This scourge deprives them annually of their most promising crops. It appeared at first only in a few hamlets, but soon made a rapid progress, and has now spread to the lands of upwards of two hundred parishes. Famine and the most fatal epidemic diseases have often taken rise from less beginnings. Messieurs Duhamel and Tillet were deputed by the Academy of Sciences at Paris, of which they are members, to enquire into the nature of this insect, and the means of preventing and curing the dreadful calamity occasioned thereby. They have jointly published a small treatise on this subject^a, from whence I shall extract the following remarks so much the more readily, as their means of prevention and cure in this particular case may be equally applicable to the injuries done to corn by insects in general.

This insect is most generally known as a butterfly, very much like the moth which preys on woollen cloths, or the false moth which is found in great quantities in the granaries of all countries, and which feeds on corn. M. de Reaumur, whose accurate inquiries into nature nothing can escape, has minutely described both these insects*.

The butterflies which proceed from the wheat caterpillar are often smaller than the false

^a *Histoire d'un Insecte qui devore les Grains de l'Angoumois.*

* In the 2d and 3d Volume of his *Memoires pour servir à l'Histoire des Insects.*

moth. Some of them are, however, larger, and longer shaped: but, that excepted, they are much like them: they are likewise of the class of four-winged *phalena* or night butterflies; their wings are long in proportion to their length, which is almost equal at the upper and the lower end. The colour of the upper wings varies; being sometimes of a light, and sometimes of a darkish grey brown, but always shining when exposed to the sun. The position of these wings, of which the edges are close set with long hairs, is horizontal when the insect first settles after having flown; but soon after those edges incline downward. It's head (*PL. I. Fig. 24, 25, 26.*) is furnished with two *antennae* (*Fig. 27.*) the joints of which, nicely fitted into each other, lessen gradually up to the point. It's eyes are almost as large as those of the false moth. Between the *antennae* are two beards (*Fig. 28.*) which proceed from the lower part of the head and rise up above it; and likewise between the *antennae* is a tuft of hairs which turn up backward.

These insects do not take any food while they are in the state of butterflies, as will be proved by several experiments; nor do, or indeed can they, prey upon and destroy corn during that time, as is the general, but mistaken opinion in Angoumois; for they have not even organs capable of doing it the least injury. Their only function then is to procreate their species.

The males of these butterflies seem, in general, to be larger than the females: but they cannot well be distinguished with certainty, unless they are seen coupled together, which, according to the very nice and careful observations of Mefs. Duhamel and Tillet; never is but in the night time, or in a dark place. Their copulation then is like that of the silk-worm butterfly: the body of the

male

male and that of the female then form one strait line; their heads are turned different ways; the ends of their wings rest upon each other; and their conjunction lasts several hours. The above-mentioned gentlemen, with many other witnesses, saw great numbers of them in this situation, both upon heaps of corn in granaries, and upon ears of corn in the field. They caught two of them in the act of copulation, and put them into a glass covered over, where they then separated, but were found joined together again the next day, in the evening.

As soon as the female is impregnated, she lays her eggs in great numbers. Messieurs Duhamel and Tillet put a male and a female, coupled, into a glass vessel, and, watching them carefully, saw the female, soon after her separation from the male, deposit her eggs, sometimes on one spot and then on another, in heaps of 50, 80, or 90 together. These eggs are squirted out, as it were, commonly by three, four, or half a dozen, and sometimes thirty, at once; and at each squirt of this kind the female changes her situation. Those which were inclosed in glasses cast some of their eggs upon a few grains of corn deposited at the bottom of those glasses, and, finding themselves cramped there, laid others on the sides of the vessel. These eggs are accompanied with a viscous matter which makes them stick to the places they are laid in; and this cohesion soon becomes very strong.

These eggs, as may easily be imagined from the size of the mother and the great number which she lays, are so extremely small that one of them would drop through a hole made in a bit of paper with the point of the finest needle. When examined with a microscope, they look, as in *Fig. 4*, not unlike the *nymphs* commonly called *ants eggs*.

They

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They are streaked length-wise, and appear rough, or curdled. When first laid, they are white; and afterwards they become red, as if tinged with carmine; owing to the colour of the caterpillar within the egg, of which the shell is very thin and transparent, as is evident after the caterpillar has left it.

By means of the thinness and transparency of this covering, the caterpillar may be seen within the egg; as at *b*, *Fig. 5*. At first it is bent as in *Fig. 6*: some time after, it wriggles itself into the situation represented in *Fig. 7*; and then it makes a hole through the end of the egg, and comes out there, as in *Fig. 8*. This opening remains at the end of the empty eggs, as at *c* in *Fig. 5*.

It is with great difficulty that the caterpillar gets its two first legs out of the egg; but after it has extricated four or six of its legs, it soon draws out the rest of its body. At its first issuing from the egg, this caterpillar looks like a bit of hair about a quarter or a fifth part of an inch long.

These caterpillars generally come out of their eggs on the sixth or seventh day after they have been laid. Some say they have seen them hatch at the end of four days. The temperature of the air will undoubtedly influence this variation. They are red, as was said before, whilst in the egg; but that colour goes off by degrees after they are hatched, and they soon become almost white.

The female butterflies which are upon the ears of corn in a field endeavour to place themselves in such manner as to lay their eggs close to the place, where the grain is fastened to the stalk. *Fig. 1.* represents some of them, at *a*, in the attitude of thus laying; in which case their eggs are deposited near the bottom of the grains, toward the stalk; but it often happens that, in their
hurry

hurry to lay, they scatter their eggs in other places, as represented upon the husks in *Fig. 2* and *3*.

As soon as the caterpillars are hatched, they set about making their way into the grain, in order to feed upon it's flour. If the eggs have been laid in the granary, after harvest, and upon the grains themselves, they generally creep into the furrow *a* of the wheat (*Fig. 9* and *10*), and there weave a slight web *bb*. They then tear a hole in the skin or rind, range around them the particles of the bran thus separated, and wriggle themselves into the mealy substance which is to be their food. The hole through which the caterpillar entered can then no longer be perceived, but by a little heap of bran which lies upon it, as in *Fig. 11*. The small quantity of pulverised bran, which is a sure sign that a young caterpillar has got into the grain, may easily escape the notice of those who have not observed it before; but when once known, it is easily distinguished.

When the eggs are hatched upon the ears, in the field, the young caterpillars soon find means to glide in between the chaff and the grain, and in that situation they pierce the latter, as was said before, generally in the furrow, but sometimes at the pointed end, which is a little hairy.

To set this in a yet clearer light, it is to be observed, that, in most kinds of wheat, three grains of corn adhere, or are fastened, at the same height, to the spike or stalk which traverses the ear, as at *bbb*, *Fig. 1*, in such manner as to form a sort of triangle, or flower-de-luce. Each grain is covered with three concave coats or husks, the smallest and thickest of which is represented by *Fig. 2* and *3*: their inner husk is covered by a broader, but thinner; and this again is covered by a still larger, from which arises the beard, when there

there is one. Over all these there frequently is a fourth tegument, or very thin membrane, more or less wide. All these husks lap over each other like the scales of a fish, and envelop the grain. The end *e* (*Fig. 9.*) is uppermost, and the end *f* rests upon it's supporter. The germe is at the end *f*, and the extremity *e* is covered with a hairy down.

The young caterpillar finds means to creep under all these scale-like coverings, and to get at the grain, which, after having wove a slight web of only a few fine threads, either to cover itself, or to hold by, it attacks, sometimes at the upper end *e* (*Fig. 9.*), which is very soft in green corn; and sometimes, if it has crept in at the lower end, it lodges in the longitudinal furrow of the grain, and there begins to mine in the manner before related.

As the husks of barley are harder, and stick much closer to the grain, than those of wheat, it is almost always at the point *d* (*Fig. 12.*) that these caterpillars slip into that corn, by means of a small opening generally perceptible in that part.

To conceive how these small caterpillars, which are hardly able to pierce the rind or bran of wheat, can glide into barley by means of the opening before mentioned, it is necessary to consider the organisation of this grain. It is formed of two lobes *cc*, *Fig. 12.*, which are partly separated by a furrow in it's middle, and partly covered by a tegument *aa*, which fits exactly close and adheres strongly to the lobes *cc*, and terminates in a long awn or beard *b*, of which only a part is represented in this drawing. The two lobes *cc* are again covered with their proper tegument, which ends in two small appendices at *d*. Here generally is a chasm or opening, through which the caterpillar penetrates to the mealy substance.

To

To trace this caterpillar in it's farther progress after it had crept in at this opening, and consequently disappeared; Messieurs Duhamel and Tillet tore off the appendices *d*, *Fig. 13*, and found, that after having wove a slender web, it had immediately begun to attack the lobes of the grain of barley, as was evident from the bran around it. After it had made its way entirely into the grain, and was buried there, they saw nothing but the little heap of bran it had thrown up, over the hole through which it entered.

Notwithstanding the industry of this insect, it seems highly probable that the young ones meet with great difficulties in their attempts to get into the grain; since very many of them die before they can effect a lodgment in the mealy substance. This number is so great, that it might induce one to wonder how such quantities of corn can be destroyed by these caterpillars, if one did not consider the vast fecundity of the female butterflies. But the sequel of this account will shew, that if prodigious numbers of them did not perish, it would hardly be possible to save a single grain of any kind of corn.

The people of Angumois were strongly of opinion that the mischief occasioned by this insect was peculiar to the corn of their country; and that what was brought to them from other places always escaped unhurt. To clear up this point, Mefs. Duhamel and Tillet put into different glasses wheat of the growth of other provinces, and with the grains, in each glass, some of these butterflies actually coupled. They soon saw the female lay her eggs upon these grains, and afterwards beheld the caterpillars hatch, and make their way into the grains. Their farther observations proved, that the principal cause of the spreading of this evil is, that the insect itself, which multiplies exceedingly,

is conveyed to other parts with the corn in which it is enclosed.

The caterpillar inclosed in a grain of corn preys upon the mealy substance of that grain, till it has eaten it all; by which time the insect has attained it's full growth. Whenever a grain was opened (*Fig. 19.*) in which the caterpillar was not full grown, a great deal of flour yet remained: but when this insect was full-grown, there remained only the skin, or bran, so destitute of flour as not even to discolour clear water. Hogs, though very greedy creatures, and fond of bran, would not touch these hulls when given to them unmixed; but they eat them readily enough when mixed with other food.

M. de Réaumur suspects that when these caterpillars have consumed all the flour, they eat the excrements which they had voided whilst young. At least it is certain that, upon opening several grains in which the insect was young, a number of small white pellets, like eggs, was found near the caterpillar; and a half grown caterpillar being taken out of a grain, and laid upon a piece of glass at the focus of a microscope, it was seen to void a quantity of excrements, very white, smooth and oval; and when the caterpillars were ready to be metamorphosed in the spring, there remained only a very small portion of dark brown excrements, quite different from the white that were observed at first.

The length of the corn-caterpillar, when full grown, is very little more than the twelfth part of an inch; and it's thickness is, at most, equal to half the circumference of the grain that contains it: it's body is smooth and entirely white: it is thickest towards the head, in which one may perceive it's mouth, two large eyes, and two kinds of horns: the head is a little browner than the

the rest of the body. This caterpillar has sixteen legs, of which the eight intermediate and membranous are only small prominencies, so minute as not to be distinguished even with the help of a microscope, unless the insect be laid upon it's side.

My authors make here the following digression, to shew the difference between this insect (*Fig. 23.*) and the false moth (*Fig. 31.*); it being the more important to distinguish them, as they are very much alike in many respects, and often blended together in the same granaries.

The false moth proceeds from a small caterpillar, the body of which is smooth and whiteish. It has sixteen legs, does not lodge in the grains of corn, but contrives to fasten several of them together with a web which it spins, and with which it makes itself a dwelling place like that of common caterpillars. This dwelling place, or sheath, in which the caterpillar of the false moth usually abides, is generally in the middle of the little heaps of grains which it has collected for it's food, as in *Fig. 30*: but, which distinguishes it from the caterpillar of the true moth, it can quit this sheath at any time, to eat the grains around it, one after another. It generally attacks several grains at once, and always without order, eating sometimes of one, and sometimes of another, so that several are gnawn when not one is wholly consumed. When these insects are very numerous in a granary, all the grains upon the surface of the corn are linked together by a web, so as to form a crust which is sometimes three inches thick. This caterpillar turns into a chrysalis, or aurelia, in a grain which it has hollowed, or in the sheath of it's web, and issues from thence, in the month of June, in the form of a butterfly. When a heap of corn is stirred in which there are many cater-

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pillars of the species of this false-moth, those insects crawl upon the walls: but they soon return to the heap; and, by the very next day, cover it all over with a new web.

The insect which desolates many parts of Angoumois is more sparing of the mealy substance of the corn, than the caterpillar of the false-moth; for the former seldom consumes more than the contents of a single grain. Nothing is more common than for it to pass from one grain to another, even though it be immediately contiguous. It eats the flour in such manner that the skin or rind of the grain, which is entirely emptied, looks whole and sound: but the least pressure then easily reduces it to powder; and it rises up to the surface of water more or less quickly, according as the insect has left in it more or less flour.

As heat hastens the metamorphosis of the insect, it is not unusual to find, in very hot weather, some of these caterpillars transformed into *aureliæ*, before they have consumed the gross excrements before mentioned, or even eaten all the mealy substance of the grain. In this case, the *aureliæ* are very small, and produce only small butterflies. The same happens to other insects of this kind. Silk-worms eat but little when they are sickly, and if that sickness continues, they are metamorphosed sooner than others which are healthy: but then their cocoons always are small. If a field-caterpillar be shut up in a box before it has attained it's full growth, it will, after having fasted some days, be converted into a small *aurelia*, from which will issue a butterfly smaller than others of the same species. In like manner, when one sees among the corn caterpillars some larger than others, it may reasonably be presumed that this difference proceeds from there having been a greater quantity of flour in the grains on which they

they fed, than in those which were the nourishment of smaller flies; or from their having been of a stronger constitution. It likewise appears that some of these caterpillars are so much more voracious than others, that the flour of one grain is not sufficient for them. M. Duhamel put several of them into a box of flour: they throve there, and seemed to grow larger than in their common way of feeding in the grain.

In general, they are metamorphosed much sooner in summer and when the air is warm, than in winter, or in cold weather. It may likewise be observed, that the mealy substance of a grain is more completely consumed when the metamorphosis is slow, than when the contrary happens.

The sagacity of M. de Réaumur was requisite to discover a singular circumstance relative to the working of this insect, and of which Mess. Duhamel and Tillet have been witnesses. The caterpillar, exactly inclosed in it's grain, foresees, or acts as if it knew, that, in its future state of butterfly, it will be deprived of the organs necessary to pierce through the rind of bran which forms it's prison. However, whether it has or has not that foresight, the fact is, that the caterpillar, before it is changed into an aurelia, makes in this covering of bran a small trap *a* (*Fig. 21.*) which remains shut. Messieurs Duhamel and Tillet could not easily discover it at first; but after some search, a little spot whiter than the rest, about as big as the head of a small pin, and somewhat prominent, shewed them where it was. They then, upon lifting up this trap (*Fig. 22.*) with the point of a fine needle, could see the chrysalis in the inside of the grain, and could also, sometimes, close the trap again so exactly as not to leave the least appearance of a hole.

When the caterpillar has attained it's full growth, and formed it's trap, or outlet, it weaves a cocon, and is afterwards metamorphosed, within the grain, into an aurelia (*Fig. 20.*) which seems at first to be divided by ringlets (*Fig. 14.*): but when the butterfly is formed within the aurelia, it's wings may be discerned through the membranes which cover it, as in *Fig. 15, 16, 17, 18.* The abovementioned accurate observers opened some of these aureliæ in an advanced state, and took out of each of them a butterfly greatly rumpled and benumbed. When one of these caterpillars first issues out of an egg, and when a full-grown one is taken out of a grain of corn, the body of each, then seemingly more at ease, dilates, so that one can hardly conceive how it could be contained in so small a space as that from whence it came. The case is different when one opens a grain in which there is an aurelia; for it is easily seen that this occupies little more than half of the inner capacity of the grain which incloses it, and that the caterpillar, in forming a cocon, has divided the grain into two spaces or cells, in the largest of which, being somewhat more than half, the aurelia is lodged, whilst one sees in the other nothing but it's excrements. The aureliæ are therefore small in comparison to the caterpillars that were metamorphosed into them. Nor is it less surprizing how a butterfly just come out of the aurelia could be contained within that covering.

The butterfly, being entirely formed in the aurelia, breaks the skin of it at the end, opens with it's head the little trap which the caterpillar had made on the outside of the grain, and comes out at the little hole which was covered and shut by that trap. The mealy substance of the grain has, by that time, been so far consumed, and the outside

Fig. 1.



Fig. 2.



Fig. 3.



Fig. 4.



Fig. 13.

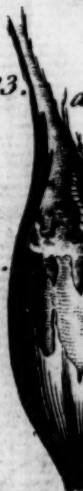


Fig. 11.



Fig. 12.



Fig. 24.



Fig. 25.



Fig. 26.



Fig. 5.



Fig. 6.



Fig. 7.



Fig. 8.



Fig. 9.



Fig. 10.



Fig. 14.



Fig. 15.



Fig. 16.



Fig. 17.



Fig. 18.



Fig. 19.



Fig. 20.

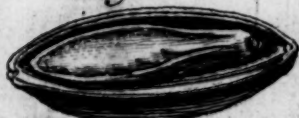


Fig. 21.

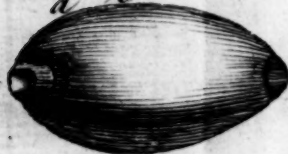


Fig. 22.



Fig. 23.



Fig. 28.



Fig. 29.



Fig. 30.



Fig. 31.



Fig. 27.



Fig. 26.



outside husk or bran tendered thereby so light, that the butterfly, after having disintangled it's wings, takes it's flight, and sometimes carries away the empty hull. As soon as the butterflies are out of the grains which contained them, they couple, and the females lay their eggs in the manner before related. Such is the circle of their life.

This insect, like all others of the same species, remains, as was said before, a longer or shorter time in it's different states, according as the temperature of the air is more or less favourable to it's several changes. It is known that an aurelia of a caterpillar, which generally produces a butterfly in eight days, will continue three months in the state of an aurelia, if it be put into an ice-house, and that the butterfly does not, in that case, come out, till after it has been removed into a much warmer air. For this reason one cannot fix precisely the time within which the caterpillars are transformed into aureliæ, nor how long they remain in this state: it can only be said, that they come out of their eggs very soon when the air is warm, and that they sometimes continue long in the state of caterpillars, as well as in that of aureliæ, if the weather be cold: to which may be added, that both caterpillars and aureliæ, of different sizes, are seen in the field in warm weather; that butterflies are seen to issue out of corn from harvest till the end of September; and that caterpillars of various sizes may be found in the infected grains during the whole winter.

"In the middle of May 1761," continue Messieurs Duhamel and Tillet in their account of this insect, "when we arrived at la Rochefoucault, there were many caterpillars in the corn, very few aureliæ, and not many butterflies. The weather was then very dry, and the nights were cold. On

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the 21st, the wind changed to the west; and in a few days after, it began to rain, and continued so to do till the end of the month. During this time the thermometer was at from 13 to 14 degrees of Réaumur, or from 56 to 58 of Farenheit.

“ In the beginning of June, we found in the grains of corn many more aureliæ than caterpillars; and on the 5th of that month, the air being then become pretty warm, we saw numbers of butterflies. By the 15th, they were increased so prodigiously in the closets where we made our experiments, that they perfectly darkened the day, and flew into our mouths if we opened them. We could then find but very few caterpillars, except in the corn which had been laid in cool places. We believe that the duration of the life of the butterflies is, in general, a fortnight or three weeks; though some of them have lived a month in our glass vessels. The sequel will shew that the whole circle of the life of this insect may be completed in less than fifty days, when the air is warm.

“ The coming out of the butterflies is generally denoted by a great heat in the heaps of corn, or in the sheaves, according as the grain is laid up in one or other. It was such as to make the liquor in M. de Réaumur's thermometer rise to 25 and 30 degrees (from 62 to 71 of Farenheit) when the outer air was at 15, (35 and half of Farenheit). This heat certainly accelerates the hatching of the insects; for prodigious multitudes of butterflies issue out of the heated corn in a few days after the ferment has taken place.

“ The coolness of autumn interrupts their propagation; and no more butterflies appear from that time, till the warmth of spring begins to be felt. But, may not the heat which favours the multiplication of these insects be produced by the creatures themselves when assembled in vast numbers?

bers? This is very possible: for it is well known that there is a considerable warmth in well-stocked bee-hives; and that corn greatly infested with weevils or moths is also very hot. We shall hereafter have occasion to observe that no sensible heat is perceived in heaps of grain in which there are but few caterpillars, and that the heat abates after most of the caterpillars have been changed into butterflies. It sometimes happens that, through some cause or other, the heat goes off soon, and at other times it lasts three weeks or even a month. Perhaps too this great heat of corn full of caterpillars may proceed from the moisture which those insects occasion, and from thence may arise a fermentation capable of hatching the eggs, of making the caterpillars grow, of hastening their transformations, and of bringing forth the butterflies, at the same time that it damages the corn, which thereby contracts a bad smell. It is certain, that when the harvest is wet, and warm rains fall at that time, the corn heats very soon, and then these insects make an extremely rapid progress. The heat which the corn contracts is doubtless very favourable to that progress, and the insects certainly may then attack the grains softened by the moisture, more easily than they can those which are hardened by drought. Accordingly, in 1760, a year in which the heat was great, and the air very dry, the corn in Anjou kept cool so long that many of the inhabitants of that province thought there would be but few insects, and that the great heat of the sun had killed most of the caterpillars. They flatter themselves with the same hopes whenever these insects do not appear in great numbers quite so soon as usual, and imagine that few or none of them will come afterwards: but in that very year, which they thought so fatal to insects, we saw butterflies come out of the ears of corn while they were in the reapers hands; we
saw

saw still more fly about the sheaves laid up in barns, and an inexpressible multitude upon the surface of corn deposited in granaries, though neither of these grew very perceptibly hot till about the middle of September. In 1761, the corn was so much heated on the 8th of September, that though the outward air was of the same temperature as that in the vaults of the observatory at Paris, Reaumur's thermometer placed in one of those heaps rose to 53 degrees, (131 of Farenheit's). The great heats of the summer had therefore only deferred the evil, and perhaps lessened it a little. But this dreadful scourge returns every year. These caterpillars, inclosed in their grain of corn, and sheltered in barns or granaries, are screened from the vicissitudes and rigour of the air which destroy other insects that are exposed to them.

" Let us now review our insect in all the seasons of the year, in order to try to find under what circumstances it may be attacked with most advantage.

" At harvest-time, we saw butterflies come out of some grains, which were already empty and entirely consumed, before they were reaped. Doubtless these first butterflies couple and lay their eggs upon the other un-reaped ears, and probably part of those eggs are destroyed by the action of the flail, when the corn is threshed and cleansed soon after it's being cut: but as the caterpillars are hatched very speedily in hot weather, and many of them can, as in fact we saw them, enter into the corn that is reaping, and shelter themselves there; they will do all their mischief, if speedy care be not taken to stifle them, as we shall hereafter observe.

" The reaped corn is laid up in sheaves, in barns, till the husbandman can find time to thresh it, which is sometimes sooner and sometimes later.

The

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The corn thus piled up, heats; and the transformations of the insects inclosed in it are then the sooner effected. When any of these piles of sheaves were stirred in our presence, we saw butterflies come out of them, and the grains from which they issued were empty of flour, and absolutely spoiled. The moment these butterflies are out of their prison, they couple, and lay their eggs upon the ears which they find in the barn. Part of these eggs, and of the young caterpillars, might certainly be destroyed by the flail and winnow, as we said before, if they were used speedily.

“ Many peasants in the country we are speaking of make all the haste they can to thresh their little crops, which they generally do upon a very dirty floor made in a hurry in the open air. They winnow and cleanse their corn as soon as it has been threshed; and the empty grains are then partly separated from those that are full, by the wind which carries the lightest away with the chaff.

“ As the dirtiness of the floor on which the sheaves are threshed fouls the grains of corn, these people wash them, and thereby take off such of the remaining light grains as swim upon the water. They likewise separate the grains of which the caterpillars have eaten so much of the mealy substance as to render them specifically lighter than the water: but the grains of which the caterpillars have not eaten much of the flour, sink to the bottom with the sound ones; and the caterpillars devour those infected grains after they are softened by the water, much sooner than those which are thoroughly dry.

“ Most of these peasants, knowing the ill-fate that will attend their corn, sell it as soon as possible to dealers, who carry it into the neighbouring

ing provinces, and with it the contagion. This is the real cause which spreads the evil. Others have their corn ground immediately after harvest; and this is the best method they can take, though not without it's inconveniences: for, in the first place, there are not mills enough in the country to grind immediately the whole produce of the crop; secondly, the meal of corn gathered in a wet harvest will not keep long; and lastly, though the friction of the mill-stones undoubtedly destroys almost all the insects, it is not certain but that some of them may escape; and in that case they will thrive, and go through their several metamorphoses, first into *aureliæ* and afterwards into butterflies, in the flour, as we have experienced in the manner before related.

“Several of the inhabitants of the country in question lay their corn up in granaries, in order therewith to pay their rent, which, in general, is not due till the beginning of October. From these heaps of reserved corn issue multitudes of butterflies, which, as we have observed, couple and lay upon that corn an immense quantity of eggs, from whence proceed caterpillars which get into the grains, and devour their inside during the whole winter.

“It is highly probable that, in mild and moist autumns, some of the first-hatched caterpillars may be changed into butterflies early enough to produce a second generation before winter; nor will this seem surprising to those who know how rapidly warm weather makes these insects go through all their metamorphoses. But, independant of this, it is certain that butterflies are continually seen to come out of all the heaps of wheat, barley, and rye, in Anjou, during the whole summer, and till the autumn begins to grow cold; that numbers of live caterpillars are found in the grains during

during the winter ; that many *aureliæ* are found in them towards the end of May ; and that prodigious multitudes of butterflies issue from them as soon as the weather begins to be hot, that is to say, towards the middle of June.

“ Thus we see that there are, in a manner, two flights of butterflies ; one which appears from harvest-time till the weather grows cold in September, and the other which appears in June and lasts till harvest. The former, in our opinion, proceed partly from granaries in which corn of the preceding year has been laid up with young caterpillars in it, and partly from the eggs first laid upon the ears, towards the end of May, or upon the new reaped corn ; so that the second flight begins just as the first ends.

“ A circumstance well worth observing, and which will be more particularly noticed hereafter, is, that most of the butterflies of the summer flight remain in the granaries, fast clung to the threshed corn, upon which we have seen them couple and lay their eggs. It looks as if these butterflies knew that there then no longer is in the fields any corn fit to feed their posterity. On the contrary, those of the spring-flight endeavour to get out of the granaries, and do in fact get out in vast numbers, through the windows, to spread in the field, and lay their eggs upon the yet green corn.”

That this is really the case, and that these insects are of the species called *phalænæ*, appeared evidently from several very accurate observations, made by Messieurs Duhamel and Tillet, and of which it may be sufficient to mention here only the following.

In June 1761, they went at different hours of the day, into granaries where there were heaps of corn infected with these insects. While the day

day lasted, they perceived a multitude of butterflies which stirred a little upon those heaps, but did not quit them. When they returned into the same granaries a little after sun-set, they saw those butterflies rise from the corn, and fly to the walls, where they settled for a while; after which they took their flight in vast numbers, through the windows, and went off with such rapidity that they soon got out of sight. If Messieurs Duhamel and Tillet went back into these granaries at ten or eleven o'clock at night, they no longer saw so great a number of butterflies, and those that did remain seemed to be less agitated.

To be still more perfectly acquainted with some circumstances of the life of this insect, they put different sorts of corn into small closets, in September 1760, after having pasted white paper all over the walls and ceiling. In the beginning of June 1761, these closets swarmed with butterflies, which seemed to be pretty quiet during the day, and were seen to be greatly agitated towards the setting of the sun: but they could not get out of the closets because the windows were closely shut. On the 9th of June, towards eight o'clock in the evening, one of the closet doors being opened, a prodigious number of butterflies immediately issued out, and, with surprizing swiftness, traversed an opposite granary, without making the least stop, though several heaps of wheat lay in it. They bent their course directly to an open window of the granary, at some distance from the closets, and instantly hastened out. Several people, who were present, followed them with their eyes, till the ridge of a barn near forty feet off, and the decline of the day, prevented their seeing them any further. Our observers returned to the same closet at about ten o'clock at night, and then found the remain-
ing

ing butterflies very quiet, scarce one of them attempting to fly out.

These observations prove sufficiently that this species of butterflies is nocturnal, and that those of the June flight have a different instinct from those which do not appear till after harvest. These last remain upon the corn in the granary, and there couple and lay their eggs, from whence proceed caterpillars which penetrate into the grains as soon as they are hatched. The June caterpillars, on the contrary, act as if they knew that the blossoming of the corn is past, and that it's ears are fitted to supply their posterity with the necessary food. They seldom leave the granary before sun-set, unless dark clouds chance to beguile them earlier, in which case numbers of them become the prey of swallows and martins, which fly about the windows.

As these little insects fly very swiftly, and rise to such a height that the eye cannot follow them long, especially when the dusk of evening begins to come on, Messieurs Duhamel and Tillet were obliged to try several methods before they could be certain what became of them. The caterpillars which they found in the grains of standing corn made them conclude that the butterflies, when out of the granary, flew directly to the green corn, and laid their eggs upon it's yet tender ears: but none of the country people, of whom they inquired, had ever observed them in the fields, or could give any satisfactory account of them. Another well attested circumstance, which strengthened their conjecture, was their being assured by persons of undoubted credit, that the corn which grows nearest to villages, farm-houses, barns, or buildings used for granaries, is always much more damaged by insects than that which grows at a distance from any habitation. Their own observations confirmed

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firmed this fact; and their experiments, dictated by reason, soon proved that they had conjectured right.

Desirous to know what was become of the swarms of butterflies which they had seen go out of the granaries in June 1761, they searched all the neighbouring fields of every kind of corn, and beat even the surrounding hedges, at all hours of the day, to no sort of purpose: not a butterfly could they find, excepting a few dead and dried ones intangled in spiders webs along the outside of the corn. This very circumstance led them to the discovery they were in quest of: for, rightly reflecting that these insects, which neither they nor any other persons had been able to find in the fields in the day time, must certainly be of the *phalene* or nocturnal kind; they, without farther delay, set out with a candle and lanthorn, repaired to one of the corn fields which they had visited in the afternoon, and, in the night between the 5th and 6th of June, soon described a great number of the very butterflies they were seeking for, upon the beards of the ears of wheat. They returned to the same spot early the next morning, and could not then find a single one.

From that time they saw and shewed to whoever chose to see them, a great number of these butterflies upon the standing wheat and barley. Some were upon the beards, and others had made their way to the point of the grain. Scarce an evening passed without their seeing some of them coupled. Though every circumstance concurred to prove, and indeed left no room to doubt, that these butterflies were the same as those which infested the corn in granaries; yet, to be thoroughly convinced, and to convince others, in this respect, they took some of them from off the ears of corn in the field, examined them with a microscope, and found

found them to be of the very same species. A farther demonstration of this resulted from the following incidents. M. de Taponnat, one of their friends in Angoumois, had, in a small granary, several heaps of wheat differently prepared, which he kept by way of experiment. Messieurs Duhamel and Tillet, observing numbers of caterpillars in two of those heaps, advised him to put that corn into an oven properly heated, in order to prevent the dispersion of the butterflies, which they knew would otherwise infallibly proceed from thence: but this was neglected. On the 21st of June, about seven o'clock in the evening, they visited this little granary, and found upon the corn a multitude of butterflies in great agitation, and of which a considerable number soon flew out at the windows. They took leave of M. de Taponnat, assuring him that this flight of insects would soon light upon his standing corn. When they were gone, M. de Taponnat had the curiosity to step out, to see whether any great quantity of butterflies still continued to issue from his granary; which he could easily do, as the window was very low. He was amazed at the numbers he saw fly out at that one window; being, as nearly as he could compute, about fifty in a minute. He observed, that they directed their flight towards a field of wheat not far off, and thereupon went thither with five or six other persons, all of whom saw them arrive in swarms, proceeding chiefly from the granary. They saw many of them light upon the ears, and on their running ~~gently~~ gently over the awns, beheld them rise by dozens at a time. M. de Taponnat was so struck with this sight, that he ordered the window of his granary to be shut the next day, and his corn to be put in an oven properly heated, as soon as possible.

A clergyman in the neighbourhood, who had a little barley infested with these insects, could not be persuaded to do the same, though his whole quantity was but a few bushels. The consequence was, that a multitude of butterflies were soon seen to proceed from the window of his granary, and spread so thick over an adjacent field of barley, that not an ear could be found without several of them upon it.

These facts confirm all the former remarks of our accurate inquirers, who, after observing that the fittest time to find these butterflies upon the ears of standing corn, is about half an hour after sunset, continue thus.

“ On the 10th of June, about eight o'clock in the evening, we visited the fields around la Rochefoucault, and then perceived only a few butterflies upon the ears of the corn: they were greatly agitated; and we soon after saw numbers of the same species arrive on all sides, but chiefly from certain mills on the banks of the river. Those that were upon the corn flew away as soon as we approached them with a light. This was probably the time of their arrival. Towards nine o'clock we renewed our search, and saw many of them clung to the ears, either actually coupled, or seeking to couple. The light did not affright them, then, and we had time enough to examine them with a microscope. We found fewer of them towards midnight, and could not see any early the next morning. It is not to be supposed that the dispersion of these butterflies happens always regularly at the hours before mentioned; for we have observed several variations, which depend on the warmth of the air; and they commonly settle upon the corn earlier when the sun is over cast with clouds just before it's settling.

“ As we have not ever met with these butterflies in the day-time, it may be asked, where they then

then retire to? This question deserves an answer. We have searched for them in vain in hedges and among the blades of corn. Light certainly incommodes them: for when we exposed to the sun vessels in which some of them were inclosed, they hid themselves in the shade formed by creases of the paper at the bottom of those vessels, in such manner that we were sometimes puzzled to find them again. One day that the sun shone very bright, we took two crystal cups, into one of which we put a few grains of wheat with some butterflies, then covered it with paper, and placed it upon it's bottom, in a garden exposed to the sun. We put some butterflies into the other, but not any corn, and placed it close to the former, with it's bottom upmost, that the butterflies might receive the full heat of the sun: and lastly we set one of M. de Réaumur's thermometers upon the ground, just by these cups. When the liquor had risen to from 45 to 50 degrees; (from 112 to 124 of Farenheit's), we saw that all the butterflies in the cup where there was not any corn, were dead: in the other, only some were dead; because most of them had found a shady shelter, either by making their way into the grains, or by hiding themselves under the paper cover. We know before, that these butterflies are greatly agitated and flutter very much when they are exposed to the sun; but we could not tell whether that proceeded from pleasure or pain. The doubt is now removed: and we are of opinion that they retire to a cool or shady place during the day time, and that their smallness prevents our finding where they are hidden, which may perhaps be in woods or thickets, in crevices in the bark of trees, or in the earth."

That the caterpillars which produce first aureliae and then these butterflies can, and frequently do live under ground, that they can pass the winter there inclosed in the grain with which they are

sown, and even undergo their several metamorphoses in the earth, so as to arise from thence in the form of butterflies in the spring, has been demonstrated by the following experiments.

In May 1761, Messieurs Duhamel and Tillet planted, in a garden-pot, corn in which they knew there were caterpillars. They buried it an inch deep, watched it carefully, and saw that, notwithstanding plentiful rains had fallen upon it, those caterpillars changed into aureliæ just as if they had been in a granary. These aureliæ produced butterflies, which, weak as they were when first hatched, soon made their way out of the ground.

To be the more certain of their power with respect to this last article, the same gentlemen put some thoroughly dry and well pulverised earth into a glass vessel, then laid upon that earth a layer of corn in which they knew there were aureliæ, and covered this with equally well dried and pulverised earth, at least half an inch deep; after which they tied a paper over the vessel, to keep in the butterflies, in case they should pierce through the upper mould. In effect, they did pierce through it, coupled, and laid such quantities of eggs as covered it's whole surface.

To see whether these insects would rise as easily from underneath a stiffer earth, and what effect their being buried deeper would have, a wooden box was divided into three partitions, and filled with common mould taken out of a kitchen garden. Corn known to be infested with these caterpillars was planted an inch deep in one of these partitions, two inches deep in another, and three inches in the third. All of them were then covered with a glass frame, and butterflies soon appeared in each of the divisions; but they were far most numerous in that where they had been buried but an inch deep. In another trial, a number of infected

infected grains was covered with a still stiffer earth, wetted, and pressed down; and not any butterflies appeared there. At their first coming out of the ground, they are rumpled, as when taken out of a chrysalis; but after resting a moment, they shake their wings, set them right, and soon take their flight.

That some of these butterflies can, and do come out of the plowed ground which has been sown with infected seeds, is certain: but Mess. Duhamel and Tillet are thoroughly satisfied that their number is but small, that most of the caterpillars sown with the grain perish before they can reach the surface of the earth, and that the butterflies which proceed from granaries are the great source of the increase of this insect: for, say they, the grain which contains a young caterpillar will grow, if its germe has not been damaged; and as its mealy substance is consumed by the plant, the caterpillar must die for want of food. Besides, as is proved by the last mentioned experiment, the butterflies cannot pierce through a close and hardened earth; which generally is the case of plowed land that has been exposed to the winter rains.

After observing, that the two sexes sometimes unite a second time after separation; that the female deposits her eggs almost immediately after they are fecundated, in small parcels of from six to 30, and that each female lays in all from 60 to 90; adding to this that there are generally three flights in a year, one at the latter end of May or in the beginning of June, a second in August, and a third in some of the subsequent months, during which a fourth also, and even a fifth, have been known; we may, from the following calculation, form an idea of the astonishing multiplication of these insects, and consequently of the ravages which

they must make where they have established themselves.

Every female produces from 60 to 90 eggs, of which 75 is the medium: but let us suppose the number to be no more than 70. Let us suppose also, that of those 70 eggs, one half only produces females, which makes the number 35. This multiplied by 70, the number of eggs laid by each, gives for the second brood, from a single insect, 2450: the half of this number, supposed to be females, is 1225, which multiplied by 70, gives 85,750 for the third brood. The half of this number, being 42,875, multiplied by 70, gives for the fourth brood, 3,001,250; and the half of this, 1,500,625, multiplied by 70, gives 105,043,750 for the fifth brood; so that supposing five broods in a year, each female butterfly of this species that exists in May, produces, before the May following, no less than one hundred and five millions, forty three thousand, seven hundred and fifty individuals of the same kind.

It is not agreed whether these insects prefer wheat, barley, or rye. The observations and trials made by Mess. Duhamel and Tillet seem to prove, that they attack indifferently whichever lies most convenient for them; and that they do not spare maize, when it is stripped of its stalk and laid up in a granary where they can come at the soft inside part of the grain; or even oats, though it be the common, but mistaken opinion of the people of Angoumois, that this last grain is a preservative of others, especially of barley, when sown with it, or intermixed in the same heap.

M. Tillet inclosed several ears of standing oats in a wide-mouthed glass bottle, and put into it some of these butterflies; after which he covered the mouth with a piece of fine linen. The butterflies

flies coupl'd there, laid their eggs upon the ears, and several caterpillars which proceeded from those eggs actually introduced themselves into the grains. A manifest proof that, though the pendent position of the grains of oats, whilst growing, may be inconvenient to the female butterflies, many of whose eggs may be washed or blown off, more easily than from other corn, before they are fixed by the viscous matter which fastens them to the husks; yet the corn-caterpillar can live upon oats. What is still more extraordinary, is, that grains of wheat, barley, rye, and oats, were mixed together in a glass vessel, into which some of these butterflies were put: and the oats were damaged by caterpillars, as much as any of the other grain: through it is certain that these insects do but little mischief to oats in the granary; happily for the poor people who make bread of this corn.

In guarding against these insects, the farmer has three objects: 1, to preserve his grain for seed; 2, to keep it for food and market; and 3, the total destruction of the insects.

To preserve the corn for seed, it should be threshed out as soon as possible, in order to prevent the transformation of the caterpillars brought from the field, which otherwise soon become butterflies, whose prodigious number of eggs would exceedingly increase the evil. For want of this precaution, two thirds of the store of seed-corn has frequently been destroyed.

The most effectual means has been found to be drying of the corn in an oven; in which operation it is necessary to observe, 1, that the oven be hot enough to kill the caterpillars; and 2dly, that the heat be not so great as to destroy the germe, or vegetative power of the grain. Though M. Duhamel has seen corn grow after it had endured a heat of 60 degrees of Réaumur's

thermometer; which are equal to 142 of Fahrenheit's; yet there is danger in making it undergo that heat, especially if the quantity put into the oven be but small. They who have hit on the proper degree of heat, have seen their corn rise well, and yield a plentiful crop. Others have complained of its coming up very thin, though they have sowed the seed thick. The corn of these last must either have undergone too much heat, or a great deal of it has been eaten by the caterpillars before it was put into the oven. If they had washed it in lime-water, and skimmed off all the light grains, their seed-corn would certainly have been better.

It appears from an experiment made by M. de Taponnat, that these caterpillars are killed by a heat of 50 degrees of Réaumur's thermometer (equal to 124 of Fahrenheit's), provided the corn be spread thin in the oven, that it remain there three days, and that the quantity be not more than 150 pound-weight. But if 600 pounds were put into the same oven, it must be heated to 60 degrees of Réaumur's thermometer (142 of Fahrenheit's), and be stirred from time to time; and if the quantity be 900 pounds, the heat must be increased to 70 degrees of Réaumur's (160 of Fahrenheit's) thermometer, and the corn must remain in it four days, stirring it often. The reason of this difference is, that a greater quantity of corn checks the heat proportionally, and requires a longer time to be equally heated.

As it is not easy for farmers who have not thermometers to guess at the precise degree of heat, they may take the following method, which will likewise preserve their grain from smut, &c. Let the corn be threshed and winnowed the day it is reaped. This will destroy numbers of caterpillars that have not yet pierced into the corn,
and

and with them many of the eggs lodged upon the chaff, which would otherwise produce caterpillars in a few days. As soon as a sufficient quantity of corn is thus collected, a strong lye should be made with wood ashes; and when this lye is become yellow like beer, and slippery to the touch, as much quick lime should be added as will make it of a dusky white. When it's heat is such that the finger can but just bear it, let the gross part of the lime subside, then pour off the lye into a proper vessel, and, having the grain in a basket, plunge the basket with the grain into the lye, stirring it about, and skimming off what floats on the top. This will chiefly be the grains which are become light by the caterpillars having consumed their flour. When the corn has been thus soaked for about two minutes, the basket which contains it should be lifted up, and suspended by two poles, till the lye is drained off. The grain should then be spread very thin on the floor of a granary, to dry, while a second basket-full is prepared in the same manner. The corn thus steeped and well dried will keep a year, and continue fit for sowing. Wheat thus prepared in August 1760 was sowed in July 1761, and rose very well.

That this lye certainly kills many of the caterpillars, appeared from an experiment made with 20 grains of wheat into which those insects had pierced. They were tied up in a thin rag, steeped in it, and 17 or 18 of the caterpillars were destroyed. It hardens the grain, which is so incrust-ed by the lime, that the caterpillars cannot easily penetrate into it; though the butterflies which proceed from infected corn, or from the few caterpillars which may have escaped the lye, may lay their eggs upon it, if it be less exposed, and thereby endanger it. This may be prevented by gathering

thering the corn into a heap in the middle of the floor, as soon as it is thoroughly dry, and covering it with an oil-cloth, or tarpaulin, or, which may yet more easily be done, with ashes or powdered lime, to the thickness of an inch. These will give a passage to the few butterflies which proceed from the heap, without a possibility of their depositing their eggs upon the corn. By this means the farmer will be sure to have sound corn for seed; excepting the few grains out of which the butterflies may have made their escape.

The corn which is intended to be kept for food or sale should likewise be cut down with all possible speed. Every moment then is of great importance, to prevent the rapid increase of these mischievous insects. He who can destroy them before those which are carried from the field have laid their eggs, will not lose a fortieth part of his corn; while his negligent and slothful neighbour, who defers the remedy till the middle of September, will lose half his crop; and if he puts it off, for a month longer, he will not have a sixth part left. The best way therefore is, to thresh the corn as fast as it is cut; by setting reapers and threshers to work at the same time. The wheat should be threshed first, then the barley, and afterwards the rye. Oats, peas, &c. may be left to a more leisure time. As fast as the corn is threshed, it should be winnowed, to separate the light grains, in most of which there will be insects. It must then be dried in ovens, or rather in such stoves as will be described in the following chapter, for the preservation of corn in large granaries. It is of consequence that this be done before the insects are grown big; for they occasion but a trifling loss while they are small. The corn should be winnowed again when it is taken out of the oven, to separate the remaining light grains; after which it will

will require no farther trouble than barely to secure it from the butterflies which might lay their eggs upon it. This purpose will be answered by covering it as before directed; only observing, that if it is covered with ashes, and intended for food, it must be washed before it is sent to the mill. It may remain uncovered from the time of the disappearing of the butterflies in the winter, till the middle of May, after which it will be necessary to cover it again: or, which is better than covering it in a heap, it may be put into strong sacks placed upon treffels, the feet of which should be covered with tin, to prevent mice and rats from climbing up.

When corn is dried in an oven, those parts of it which are next to the bottom and sides are sometimes parched, or even burnt, while the centre of the heap is not heated enough to kill the caterpillars. A large quantity put in together cools the oven too much, and it is long before the heat penetrates the heap. To avoid these inconveniencies, the mouth of the oven destined for this purpose should be wide enough to admit a hurdle covered with a coarse canvas, on which a proper depth of corn should be spread. The hurdle should then be shoved into the oven, the door of which should afterwards be shut, and the corn upon the hurdle must be turned from time to time. It is proper here to attend to the following observations.

1. Grain exposed during many days to a heat which causes Réaumur's thermometer to rise to 60 degrees (142 of Fahrenheit's), loses no degree of it's fertility.

2. This heat continued eleven hours will totally destroy all the insects contained in the grain, whether they be caterpillars, aureliæ, or butterflies; and heat equal to only 33 degrees of Réaumur's

mur's (94 of Farenheit's) thermometer, will answer the same purpose if it be continued two days.

3. 2500 pounds of grain being put into an oven in which the heat was 85 degrees of Réaumur's (278 of Farenheit's) thermometer; the heat in the center of the heap was, an hour afterwards, found to be no more than 19 of the former, or $66\frac{1}{2}$ of the latter. It gradually increased for 48 hours, and at the end of that time it was found to be 33 degrees and an half of Réaumur's (93 of Farenheit's) thermometer, which then was the general heat of the oven.

4. The usual heat of an oven, two hours after the bread has been drawn, is about 100 degrees of Réaumur's, or 246 of Farenheit's thermometer.

5. Grain which has endured 90 degrees of heat according to Réaumur's thermometer, which would be $294\frac{1}{2}$ of Farenheit's, is not the less fit for making bread.

M. de Taponnat put 200 pounds of wheat, upon a hurdle, into an oven which had been heated with three faggots of brush-wood. M. de Réaumur's thermometer rose to 68 degrees (equal to 154 of Farenheit's) when laid upon this corn, which, after having endured a heat of 70 degrees (160 of Farenheit's) during upwards of two hours, and being afterwards left in the oven during almost three days, was perfectly dry, and all the insects in it were killed. Sixty grains of this corn were sown, and fifty of them sprouted.

The same oven was heated again with three other faggots, and 300 pounds of rye were laid upon the hurdle, without sweeping or cooling the floor of the oven. M. de Réaumur's thermometer rose to 75 degrees (172 of Farenheit's): the oven was then opened, to lessen the heat, and the corn was drawn out at the end of 46 hours. There were

were then in it some caterpillars not entirely dried up. Out of 60 of these grains which were sown, 51 grew.

The oven was afterwards heated with two fagots; 300 pounds of rye were put into it upon a hurdle; Réaumur's thermometer rose to 70 degrees (160 of Fahrenheit's); the corn remained in this oven closed during 82 hours; all the insects in it were thereby stifled and dried up; and 60 of these grains being planted in the earth, 54 of them sprouted.

This is undoubtedly the best method of drying corn in an oven; because it is thereby preserved sound, no part of it is burnt, it is heated equally by being stirred from time to time upon the hurdle, and it will endure a heat of 75 degrees of Réaumur's (172 of Fahrenheit's) thermometer, as we have seen, without losing it's vegetative power: therefore, when corn is to be kept for seed, particularly, a hurdle should be used. The only objection that can be made to it is, that so great a quantity cannot be dried at a time in this way, as when the grain is spread all over the oven. But that inconvenience may be remedied by making the oven deeper in proportion than is usually done. Let it be, for example, 20 or 25 feet deep, and eight feet wide; though the common breadth for that depth would be about 14 feet; and let the mouth be shaped in such manner as to admit a hurdle six feet wide: now, a hurdle of which the surface is 120 feet, will contain 3600 pounds of wheat laid six inches deep. That the hurdle thus heavily laden may not be too difficult to move, at least so far as to bring it sufficiently forward at the mouth of the oven, where it may be convenient to draw it out to a quarter or a third part of it's length, in order to lay on, or take off, the corn with a shovel; it may be made to run upon eight
or

or ten small wheels; or the grain need not be laid on so thick as six inches. Perhaps it may be necessary in an oven of this depth, and not wider than the above dimensions, to make a vent hole six or eight inches wide, in the back or hindmost part, in order to let out the smoak: this hole may be shut after the floor of the oven is sufficiently heated, and the fire may then be drawn forward, that the smoak and flame issuing out at the mouth, may also heat it there.

The corn thus dried in an oven looks somewhat shrivelled when it is first taken out; but at the end of three or four months, it becomes as plump as ever: nor is it at all damaged for making bread, if it be properly managed. Some, indeed, have complained, that their meal has had a bad smell and taste, and they have been right in so saying; but the fact then has been, that a great part, perhaps half, or even more than half, of their corn was ground with the dried caterpillars in it; a circumstance which must necessarily hurt it's quality.

To obviate this defect, the corn should be dried in a stove or oven, as was said before, as soon as possible after harvest; it should be well winnowed before it is put into the oven, in order to take out of it as many insects as possible; it should be winnowed again when it is taken out of the oven, because all the grains in which the insects is dried up will then be light; and lastly, it should be washed, and all the grains that swim upon the water should be skimmed off, before it is sent to the mill. The moisture then imbibed by the grains will render them plump, like new corn, and the bran which has been exceedingly dried by the heat of the oven, will by this means be rendered supple and fit to grind. The flour of this, like the flour of very cold corn, requires somewhat

more

more yeast or leaven, to make it rise, than would do for corn that has not been dried.

As many country people are not provided with thermometers whereby to regulate the exact degree of the heat of their ovens, it is proper to observe, that the precision before mentioned is not necessary when the corn dried in them is not intended for seed; experience having shewn, that it is not the worse for making bread after it has undergone a heat of from 72 to 100 degrees of Réaumur's (166 to 250 of Fahrenheit's) thermometer: and with regard to seed-corn, a method of keeping it, without drying it in an oven, has been already pointed out. However, if any should think it most adviseable to dry that corn also, they can but try the planting of some grains before they sow the rest; and if the germe has been destroyed by too much heat, that parcel may be kept for bread, whilst another quantity is more carefully prepared for sowing.

For want of a thermometer, a piece of coarse yellow bees-wax, about the bigness of a walnut, may be laid upon a tile or a piece of earthen-ware placed upon the bottom of an inverted empty bushel, or other similar thing, put into the oven, so as to prevent it's receiving the immediate heat of the floor. If this wax is entirely melted within a quarter of an hour, the heat of the oven may be supposed to exceed 80 degrees of Réaumur's (190 of Fahrenheit's) thermometer; and if, on the contrary, only half of it is melted at the end of half an hour, the heat may be reckoned at between 70 and 80 degrees of the former, or 160 and 190 of the latter. Upon the whole, practice will supply the want of an exact regulator, as is daily seen in the baking of bread, for which every servant-wench in the country knows how to heat the oven to a proper degree.

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gree. General directions for the quantity of fuel would be of little use; because the heating of an oven depends upon the manner in which it is heated, upon it's form, and upon it's size. A general rule, highly proper to be observed on this occasion, is, that it is better to let the corn remain long in the oven, than to make it undergo a too intense heat.

In order to be certain whether corn intended for seed can be dried in the above manner, without hurting it; M. de Cers put 1200 pounds of wheat into one of his ovens, and 800 pounds into another^a. The former was big enough to contain as much bread as is made with 200 pounds of flour, and the latter only 150. Réaumur's thermometer marked 72 degrees ($164\frac{1}{2}$ of Farenheit's in the largest of the ovens, and 83 (197 of Farenheit) in the other, when the corn was put in. It remained there 48 hours; at the end of which the thermometer in the large oven marked 25 degrees of Réaumur's (62 of Farenheit's) thermometer, and that in the lesser 26 degrees of the former, which are equal to 64 of the latter. M. de Cers sowed 50 grains of each of these parcels, and all of them sprouted except one. He observes on this occasion, that as so great a degree of heat is not necessary in order to destroy the caterpillars, one may be assured that corn put into an oven an hour after the bread has been drawn, or into an oven which has been heated with three faggots, will yet be in a condition to grow. He allows, that the vegetative quality of the corn will probably be destroyed when only a small quantity of it is dried in too great a heat; for a large quantity, checks and moderates the heat of the

^a *Hist. d'un Insecte de l'Angoumois, par Mesi. DUHAMEL & TILLET, p. 277.*

oven:

oven: and he believes that the injury done to the germe by too much heat, may frequently be remedied by steeping the grain in water.

This is confirmed by M. Duhamel, who, to try the experiment, dried a parcel of corn in a stove heated to such a degree as he thought must certainly destroy the germe of every grain. He afterwards sowed this corn, and, at the end of three weeks, when he had quite given it up, almost all of it sprouted. Some grains rose sooner than others; and he thinks it highly probable that all of them would have sprouted sooner than they did, if he had steeped them in water before they were sowed.

This experiment proves that corn can bear a great degree of heat without losing it's fertility, and the fact is still farther confirmed by the following incident.

One of M. de Cers's farmers put a parcel of bearded wheat into an oven, as soon as the bread was drawn; and as his design was only to preserve it from insects, he did not care how much it was heated. A neighbouring husbandman, who was in want of seed-corn, desired to purchase some of this; and, though told that it had been greatly dried in an oven, he bought it, sowed it, and found it grow as well as any that had not been dried.

To know to what degree an oven should be heated, in order to kill the butterflies in the middle of a large heap of corn, M. de Cers had recourse to the following expedient.

The oven being heated and well swept, he put into it 1250 pounds of wheat, laid the surface of this corn smooth with a rake, placed upon it a tube of tin five feet long and three inches in diameter, and then put in 1250 pounds more of grain. The heat of the oven was then 85 degrees

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of Réaumur's (220 of Farenheit's) thermometer. After this, he introduced into the tube one of Réaumur's thermometers, and a glass cup in which there were about an hundred grains of wheat and ten butterflies. This cup was covered with a paper pierced through with many pin-holes, and both it and the thermometer were fastened, each of them, to the end of a stick, to draw them out for inspection. The oven was shut at nine o'clock in the morning: at ten, the thermometer marked 18 degrees (65 of Farenheit's); at eleven, 18½ (66 of Farenheit); at noon 19½ (68 of Farenheit); at one o'clock, it was at 20 degrees (69 of Farenheit); at ten minutes after two, it marked 21½ (71½ of Farenheit); at three, 21¾ (72 of Farenheit); at four, 23 degrees (74 of Farenheit); at five, 24 (76¼ of Farenheit); at six 25 (78 of Farenheit); at seven, 25½ (79 of Farenheit); at eight, 26 (80 of Farenheit); at nine, 27 (82 of Farenheit); at five o'clock in the morning, it marked 29¼ (86 of Farenheit); at half an hour past seven, 30 (87 of Farenheit); at fifty minutes after ten, 30½ (88 of Farenheit); at three quarters after twelve, 31 (89 of Farenheit); at half an hour after four, 31½ (90 of Farenheit); at ten minutes after seven, 32 (91 of Farenheit); at fifty minutes after nine, 33 (93 of Farenheit); and at five o'clock in the morning, 33½ (94 of Farenheit). At eleven, the heat having begun to abate, the thermometer was taken out of the tube, and placed upon the corn, where the heat was the same as within the tube: and lastly, the corn was taken out of the oven. This experiment shews that 49 hours were requisite for the heat of the oven to penetrate to the centre of that heap of corn. As to the butterflies in the cup, all of them were dead.

About

About thirty of the grains taken out of the cup being thrown into water, only one swam, and that because it contained a dead chrysalis: so that a heat of 33 degrees was sufficient to kill the butterflies and aureliæ. It therefore is, as was observed before, better to let the corn continue long in a middle heat, than to make it undergo a great and not lasting heat.

M. de Cers sowed thirty grains of wheat taken out of the cup, without steeping them in water; 30 grains of the same corn soaked twenty-four hours; and 30 grains which had lain close to the outside of the tube. All these grains grew perfectly well; and the only difference that he observed between them was, that those which had been steeped sprouted first.

He could not know exactly at what degree of heat the butterflies died, because the cup they were in chanced to be loosened from the stick which was intended to draw it out, so that he could not examine it till the end of his experiment, when he found them all dead. This determined him to repeat the same experiment with 2500 pounds of barley, which he put into an oven heated to 80 degrees of Réaumur's (211 of Farenheit's) thermometer. At four o'clock in the afternoon, the temperature of the air in the tube being at 22 degrees of Réaumur's thermometer (72 of Farenheit's), he put into it the cup, in which he had inclosed both butterflies and weevils. At fifty minutes after five, the thermometer marked 24 degrees (76 of Farenheit): the insects were well. At fifty minutes after six, the thermometer was at 24 degrees $\frac{1}{2}$ (77 of Farenheit): all the butterflies were alive. At three quarters after nine, 25 degrees $\frac{1}{2}$ (79 of Farenheit): all the butterflies yet alive. At half an hour after four in the morning, 32 degrees (91 of Farenheit): all the butterflies

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still living. At half an hour after five, 33 degrees (93 of Farenheit): two butterflies dead; all the weevils alive. At eight o'clock, 34 degrees (94 of Farenheit): only the two butterflies before mentioned, dead. At ten o'clock, 36 degrees (98 of Farenheit): four butterflies dead. All in the same state at half an hour past four in the afternoon. At three quarters after six, the thermometer marked 40 degrees (103 of Farenheit), and almost all the butterflies were dead. At half an hour after nine, 41 degrees: only the butterflies dead. At five in the morning, 42 degrees $\frac{1}{4}$ (110 of Farenheit): the weevils dead. Thus, thirty seven hours were sufficient to kill the insects. But it should be considered, that as the grains of barley are bigger than those of wheat, and consequently leave larger spaces between them, the heat probably penetrated so much the sooner through those interstices to the tube. These grains grew very well.

M. de Cers made a third experiment, in which he put, at five o'clock in the evening, 1400 pounds of wheat into an oven heated to 96 degrees of Réaumur's thermometer (240 of Farenheit's): but he did not place the thermometer in the tube till the heat was abated to 76 degrees (203 of Farenheit), which was not till an hour after. He then put into the same tube two cups, in one of which were weevils, and in the other butterflies. He separated them in this manner, because he had observed that the weevils harrassed and fatigued the butterflies by their violent fluttering. At half an hour after nine, the thermometer marked 24 degrees (76 of Farenheit): at half an hour after five in the morning, 32 (90 of Farenheit): at eight, 34 $\frac{1}{2}$ (93 of Farenheit). All the insects were then alive: the weevils seemed to be somewhat giddied; but they recovered after

after having been exposed to the air for a while. They were replaced in the tube. At one o'clock, Réaumur's thermometer marked $35\frac{1}{2}$ degrees (95 of Farenheit's), and all the insects were alive. At three quarters after nine, it was at 40 degrees (105 of Farenheit), and all the insects were dead. Here the heat penetrated into the tubes sooner than in the other experiments, because the quantity of corn was less.

M. de Cers, after ascertaining by the above experiments the degree of heat which will kill the butterflies and weevils, extended his researches to the caterpillars and *aureliæ* inclosed in the grains. To this end he put 1200 pounds of corn into a well swept oven, an hour and a half after the bread had been drawn out of it. The heat of this oven was then at 100 degrees of Réaumur's thermometer (249 of Farenheit's). He would not wait till the oven was grown cooler, because he had observed that the corn chills it so much, especially when a considerable quantity is put in at once, that the thermometer marks only the same temperature as the air of the bake house when it is first placed in the tube in the heap of corn. He put into a cup both barley and wheat in which there were *aureliæ*. Every thing was disposed as in the former experiment; excepting that a number of grains known to contain *aureliæ* were wrapped up in a paper, and put into the middle of 200 pounds of wheat, in a sack, which was laid close to the tube in the centre of the heap. The oven was shut at half an hour after five in the evening. At eight, Réaumur's thermometer marked 16 degrees (61 of Farenheit's). The next day, at seven in the morning, it was at 32 (91 of Farenheit); at five in the evening, at 38 (101 of Farenheit); at half an hour past nine, at 42 (109 of Farenheit); the next day, at eight in the morning,

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at 43 (111 of Farenheit); at six in the evening, it was fallen to 42 (109 of Farenheit); and half an hour afterwards, to 41 (107 of Farenheit). As the heat diminished thus sensibly, the corn was not taken out till eight o'clock in the morning of the third day, when, Réaumur's thermometer being at 32 degrees (91 of Farenheit's), the aureliæ were dead: a proof of which was had by putting some of them into a small microscope, with others which had not been in the oven: these last stirred visibly, while the others remained motionless. To be still more certain that these aureliæ were dead, M. de Cers kept them a month, at the end of which they were quite hard and dry; whereas those which had not undergone the like trial of an oven, were full of moisture, and only numbed by the then cold weather.

The corn that was in the sack, grew perfectly well. Therefore, if such a quantity as the above-mentioned is put into an oven immediately after it has been threshed, and an hour and a half after the bread has been drawn; and if that which is intended for sowing is stowed in a sack in the middle of the heap, and left in the oven at least 48 hours; the farmer will be sure of having seeds free from insects.

Half the quantity of fuel commonly used to bake bread, will heat an oven sufficiently for the drying of corn.

The same method will prove equally effectual to preserve corn from being eaten by the false moth, or any other insect. Only it is to be observed, that when the quantity is considerable, the heat of the oven must be 80, 90, or even 100 degrees of Réaumur's thermometer (210, 230, or near 250 of Farenheit's,) which is that of most ovens two hours after the bread has been drawn and the oven shut again; and that the corn must remain in
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the oven at least twice 24 hours. Corn dried in a stove will be well cured in 24 or 36 hours with a heat of only 45 or 50 degrees of Réaumur's thermometer (from 105 to 123 of Fahrenheit's); because it is there spread much thinner, and consequently presents a larger surface to the heated air.

By following the above directions, each individual may certainly preserve his corn from the ravages of these or any other similar insects, which prey upon it; but, for the public, where whole provinces may be in danger of being desolated by this dreadful scourge, and where nothing less than the joint and careful efforts of all can possibly remove the cause of the evil, either by a total extirpation of the insects, or by a great diminution of their numbers; the vigilance and activity of the magistracy becomes highly necessary: otherwise, two or three obstinate or idle peasants may ruin their neighbours, with only a few bushels of infected grain perversely kept without having been properly cured. So vast and rapid is the increase of these insects, that amazing swarms of butterflies, engendered in a very small heap of corn, will soon overspread the adjacent fields, and infect every ear with their pestiferous eggs. Coercive means must therefore be resorted to, in case of need, in such extremities as these: all barns, granaries, &c. must be subject to proper inspection; strict orders must be given, that no corn be kept after a certain time, without having been duly cured; every delinquent, whose obstinacy endangers the public welfare, should be rendered liable to condign punishment; and no corn should be suffered to be sent out of the country where the infection prevails, till after it has been rightly cured. At the same time, for the sake of the poor, and that the idle and indolent may have no excuse, large ovens, or stoves, should be erected

in proper places, at the expence of the public, and the corn should be cured there, at as small an expence as possible, or even *gratis*.

It is, however, to be observed, that the total destruction of the insect does not require such immediate haste as the preservation of the corn itself after it has been reaped in a country subject to this calamity: for as it is certain that the butterflies do not begin to quit the granaries till near the latter end of May; every farmer has seven or eight months time to cure his corn, either in a stove or oven, by which he will prevent, so far as relates to him, the formidable flights of those destructive creatures. Exhortations may therefore suffice from harvest time till April: but after the beginning of this month, no indulgence whatever should be shewn to any one who persists in keeping even the smallest quantity of corn that has not been properly cured.

One remark more will conclude this subject, the importance of which will apologize for the length of the foregoing detail, with those who consider that the means here pointed out for destroying a particular insect, perhaps hitherto peculiar to a single province, are equally applicable to the weevil, to every species of moths, and to the whole race of various insects which prey upon and destroy corn in all countries. This remark is, that as the insects before spoken of are known sometimes to rise out of the ground in the shape of butterflies, it will be right to wash in a proper lye, in the autumn, and afterwards to cover with ashes, the grain intended to be sowed in the ensuing spring.

It would be vain to suppose that any care or precaution can possibly destroy the whole race of these butterflies in one year. Some of them will escape the utmost diligence, wherever they abound. But,
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by following the above directions, their numbers will be visibly diminished after the first year; and just hopes may then be entertained, that the same means will at length effect, nearly at least, if not totally, their wished for extirpation.

There have been instances, and Mefs. Duhamel and Tillet mention^c one in particular, of these insects hiding themselves in hollow trees, in the winter. Many other mischievous insects are known to do the same; and we frequently see the boughs of trees and bushes, particularly those of hedges, covered, especially at their joints, with webs, which are their nests, filled with their eggs. These should, by all means, be cut off and burnt, to prevent their vast increase; or those parts should be well rubbed with a hard brush, and washed with a strong lie.

CH A P. IV.

OF THE PRESERVATION OF CORN.

IN many parts of the south, where the sun is very powerful, and the harvest-season generally dry, the common custom is to thresh and winnow the corn as fast as it is cut down, upon a floor made in the open air; or, which is oftener the case, to tread it out, by means of oxen, cows, horses, mules, and even asses, when the quantity is not great. In this last operation, the sheaves, after being opened, are spread in such manner that the ears of the corn are laid as much up-permoft as possible, and a man, standing in the centre, holds the halters of the cattle, which are made to trot round, as in a manege; whilst

^c *Addition à l'histoire de l'Insecte de l'Angoumois, p. 305.*

other

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other men, with forks, shake the straw up from time to time, and the cattle are trotted over it again and again, till they have beaten out all the grain. This method is expeditious enough: but, besides bruising a considerable deal of corn, it requires a great many cattle, and ruins the legs of the horses and mules, which are preferred before cows and oxen, for this work. In threshing in the open air, two, three, or more families frequently join their labour, for the sake of greater riddance, immediately after harvest; and in this case one often sees ten or twelve fails working together upon the same floor^a.

In countries where the weather is less settled, the corn is most commonly laid up in the ear, either in stacks or barns. The manner of making the former, and the advantages attending them, particularly with regard to wheat, which keeps better in stacks than any other way, have been spoken of in the first volume of this work^{*}; to which I shall only add, that where the barns are largest, the stacks are generally the same, and so on the contrary; that the stacks should always be placed upon a dry eminence, and be well fenced against cattle; that when the husbandman has begun to use a stack, he should house the remainder of it as soon as possible (for which reason it is most eligible to make them small and more numerous); and that stacks rightly managed save a great expence in otherwise necessary buildings.

To make the threshing floor abovementioned, and nearly the same is frequently practised for the floors of barns, the surface of the intended threshing place is dug away to the depth of about six inches, and the earth thus taken off, after being

^a DUHAMEL, *Eléments d'Agriculture*, Tom. I. Liv. 4. c. 3.

^{*} Page 403 & seqq.

well cleared of stones, is mixed with the strongest clay that can be had, and with dung of cows or oxen. This mixture is then worked together with water, till it is of the consistence of stiff mortar, and the compost thus made is spread as smooth as possible, with a trowel, upon the spot from which the earth was taken. As it cracks in drying, it must be beaten down with great force; or rolled with a heavy roller, till all the crevices are filled up; and this must be continued till it is quite solid, hard, and firm. The floor thus made must be carefully fenced in, if it be in the open air, and it will want repairing every year.

The best barn-floor, both for threshing and for keeping of corn, is that which is driest, smoothest, most completely solid, and consequently freest from cracks and holes, in which insects or vermin may shelter themselves, and even breed. The ancients were remarkably careful in this respect, as we learn from Cato, Varro, and Columella, the last of which excellent husbandmen relates particularly ^a the great pains they took, first to dig up the ground to some depth, in order to moisten it with fresh lees of oil, but not with any that had salt in them; then to mix it thoroughly with chaff, and ram it down as close as possible; afterwards, as it dried, to stop all the cracks and crevices that appeared; to continue beating it down with great force; to render it quite level; and lastly, to strew it again with chaff, which they trod in, and then left it to be completely dried by the sun. All these writers agree, that the lees of oil, thus used, prevent the growth of weeds in these floors, and contribute to preserve the corn from being plundered by mice and ants. Their barns were always seated high, and as dry as possible.

^a *De Rustica, Lib. II. c. 20.*

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A floor made in the above manner must be greatly preferable to either the stone or the common earthen floors too frequent in many parts of England, and from which such dampness has been communicated to the corn, as rendered wheat, for example, sixpence a bushel the worse, either for keeping or exporting^b. Boarded threshing floors, made of sound, thick, well seasoned planks of oak, are excellent for service, will last a long time, and may be converted into good floorings for rooms, by planing them down, after they are become too un-even for their former purpose: and as to the barn itself, which this subject naturally leads me to, the building, besides having a very dry situation, should be placed on one side of the farm-yard, but not quite contiguous to the house, from fear of fire from this last. It is usually made of wooden frames covered with planks of oak, or built of brick or stone, which ever the country best affords; and in either case, there should be such vent-holes, or openings, in it's sides or walls, as to afford free admittance to the air, in order to prevent the mouldiness that would otherwise arise from the least dampness lodged in the corn. The gable ends may always be of brick or stone, for the sake of greater solidity, and the whole may be roofed with thatch or tiles, as is most convenient. The size of the barn should be proportioned to the crop usually produced by the farm, or land, to which it belongs. Two large folding doors should face each other, one in each side, for the convenience of carrying in or out a waggon load of corn in sheaves; and these doors should be of the same breadth as the threshing floor, to afford the more light and air; the former for the threshers, and the latter for winnowing,

^b LISLE'S *Observations in Husbandry*, Vol. I. p. 344.

Over the threshing-floor, and a little above the reach of the flail, poles are often laid a-crofs from one beam to another, to form a kind of upper floor, upon which the thresher may throw his straw or haulm, to make an immediate clearing, till he has time to stow it more properly elsewhere: and on the outside, over the great doors, it will be right to form a large pent-house, made to project sufficiently to cover a load of corn, in case a sudden storm comes on before it can be housed, and also to shelter the poultry in the farm-yard, in great heat, or bad weather.

It is most adviseable, and indeed most commonly practised in countries which abound in corn, to have a separate barn for wheat, another for spring-corn, such as barley and oats, and a third for peas, tares, lentils, clover, sainfoin, &c.

Some art, which must be the result of practice, is required in the placing and piling up of the sheaves, both in stacks and in barns. The former has been spoken of^{*}; and in regard to the latter, the sheaves should, as much as possible, be pressed so close to the walls of the barn, as not to afford the least room for rats, or other vermin to creep in between them: for if they once get admittance, they will soon penetrate farther, lodge themselves in the mow, and do vast damage to the corn. Where this misfortune happens, the only remedy is to take down the mow, kill the vermin, and pile it up anew.

As the farmers in many places feed their cattle, and particularly their sheep, in the winter, with half-threshed straw^d; and as new straw is good food for horses, which are induced to eat it very readily when it still contains some grain; there is,

^{*} See *Vol. I. p. 404.*

^d DUHAMEL, *Eléments d'Agriculture*, Tom. I. Liv. 4. c. 3.

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in this respect, an advantage in threshing the corn only by degrees; besides that the grain itself is allowed to improve in it's quality when preserved in the ear, so as to attain the most perfect maturity, to sweat out it's moisture, and to acquire a degree of hardness which fits it for long keeping. About three months after it has been cut, is generally reckoned the best time for threshing wheat that is intended for keeping, and accordingly our prudent husbandmen make this the business of winter, when their presence is least wanted in the field*. But on the other hand, seed wheat cannot well be too soon cleared from the chaff, as M. de Chateauvieux's experiments have proved †; and the best way of doing this, is by striking the ears against the beam, as was said before ‡. By this method, the husbandman will obtain fine, long, unbruised straw, fit for binding up his next years sheaves, for thatching, and various other useful purposes. Of this he should always save, and stack, as much as he can spare, when it proves long and good; for wheat straw will keep perfectly well a year or two; and if there be no occasion for it in that time, it will make litter and dung at last. Barley-straw is likewise very serviceable for thatching, or to throw over stacks of barley, or peas, till they can be thatched: but oat-straw is of no great use, unless it be to cover an oarick, peas for fattening hogs, or corn for fowls. In general, an empty space should be left in the barn, if it can be done conveniently in harvest time, to receive the litter, and foddering straw, that is threshed out before cattle come to fodder; or it should be laid under some cover, for otherwise it will rot.

* Mr. Mortimer says, that no wheat threshed before March is fit to keep long, nor rye threshed before Christmas, though it has been laid in perfectly dry. *Art of Husbandry*, Vol. I. p. 148.

† See Vol. I. p. 292, & Vol. II. p. 246. ‡ Vol. I. p. 291.

Though

Though the flail be the best instrument yet known for threshing of corn, because it separates the grain from the straw and husks very effectually and expeditiously; yet, as it always bruises a great many seeds, even so as to render them incapable of growing, it were much to be wished that some method could be found, by which this essential inconvenience might be avoided. Some engine or other, provided with a number of flails, or other pieces answering the same end, might surely be made to move by water, wind, or a horse, so as to perform the business of threshing still cheaper and more expeditiously, and with less damage to the health of the husbandman, which is frequently thought to be injured by the dust, &c. which arises in the common way of threshing, as well as by the very great labouriousness of the work. This well deserves the attention and endeavours of skilful mechanicians. At all events, the thresher ought not to wear thick iron-clouted shoes whilst he is at work, especially if he is to thresh new corn, and particularly wheat; because they will be apt to bruise it. His shoes for this business should be soled with an old hat, or some other soft substance.

Mr. Mortimer^d esteems it a day's labour for a man to thresh four bushels of wheat or rye, six bushels of barley, five bushels of oats, or five bushels of beans and peas, if the corn thresh well. But Mr. Lisle says^e a good thresher assured him, that twelve bushels of oats or barley are reckoned a good day's threshing; that this very man had threshed fourteen bushels of oats daily, and winnowed them, for several days together; but that those oats yielded indeed extraordinary well: that five or six bushels of wheat are a very good day's thresh-

^d *Art of Husbandry, Vol. I. p. 151.*

^e *Observations in Husbandry, Vol. I. p. 345.*

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ing; and if the corn be clung, and yields ill, sometimes three bushels are as much as can be threshed in a day. He rates the common price of threshing at eightpence for a quarter of corn; and observes, which may account for the difference between his estimate and Mr. Mortimer's, that six bushels of wheat of the growth of a warm gravelly vale are as easily threshed in a day, as four bushels of the produce of cold hilly land; because the stroke of the flail must be forced down stronger to beat out the grain of this last, than it need to be for the former: and also, that as the straw of corn of the growth of a light soil is shorter than that of a strong clayey ground, more sheaves, and consequently more ears of this first sort may be laid together on a floor of equal extent, that can be of the last, whose longer straw requires proportionably more room.

The worse wheat is, though it be never so dry, the rougher it will feel when handled; because thin and coarse wheat is not so plump and globular as fine wheat, but is apt to be pitted and wrinkled, which of course renders it less slippery. It will handle cooler out of a stack two years old, than it will out of one that is only a year old: for in that time the mists and rimes, especially in a hilly country, will be driven into the stack.

Mr. Lisle, who makes this remark, adds^f, from his own experience, that wheat threshed in damp weather generally yields but little flour; with a great deal of bran, when it is ground; and that if it be put into sacks, it will grow musty in less than three weeks, let the weather be ever so dry afterwards: but if it be threshed when the air is perfectly clear and dry, it will keep well in sacks, for a long time; especially if these are laid upon

^f Vol. I. p. 268 and 346.

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trebbles high enough to secure them from the dampness of the ground or floor.

For the keeping of meal, in general, there is no better way than first to bolt it, and clear it from the bran, which is very apt to corrode and putrify it, and make it musty; then to tread it down as hard as possible, and head it up closely, in clean, dry, tight, and well bound casks, which must be laid in a cool dry place.

The beards of barley come off best, in threshing, when the swarths of this corn have taken the dew before their being housed. It will keep well in the mow, un-threshed, for one year; and for making it into malt, which must be done before the heat of the summer comes on, it should not be kept above a year and a half, or at most two years: otherwise it will be filled with weevils; unless it has been previously cured in a stove or kiln.

Oats, being defended with a double husk, are the grain least subject to harbour vermin. The best way to keep them after they are threshed, is to dry them well on a kiln, and then to barrel them up in clean close casks: but they should not be threshed earlier than Christmas, because they are not fit for keeping before that time.

Beans and peas always thresh best after they have sweated in the mow, which they are very apt to do, because, as the whole crop of either of them never ripens all together, the green parts heat, and communicate their ferment to the whole heap. The danger to be guarded against here is, that the ripe so heated do not give fire to the green, by which both might be either rotted or consumed; to which the bigness of their leaves, and hardness of their stalks, which continue moist and sappy a long time, will also contribute very much. For this reason farmers generally choose to stack them with-

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out doors, rather than to house them; that they may be the more thoroughly dried by the sun and air. But the best way of all is to kiln-dry them, or dry them well in the sun; after which they will keep many years, without turning or any other care, though they be laid ever so thick in the granary. As beans are a very large seed, and consequently full of moisture, it is found best to let those that are intended for keeping sweat in the mow till March, when they may be threshed without danger: for beans never give again, after they have once been thoroughly dried.

Peas are, of all grain, the most subject to rotteness and imperfection, because they are the most apt to breed worms, weevils and mites, by reason of the lusciousness and sweetness of their grain. The better they are dried, either in the kiln or sun, the former of which will generally be found most effectual in this country, the longer they will keep sound, and the fitter they will be for the food of cattle, by helping to make them thirsty; it being a just observation, that if cattle drink well, they will feed well. What is intended for the food of men should not be dried too much; because that would make the peas require double the time in boiling: nor need they be threshed for this use, but as they are wanted; or else they may be put into close casks, and headed up. In granaries, they keep best in thick heaps, or in bins; spreading of them thin upon the floor being apt to dry them too soon, and to take from them much of their sweetness and goodness.

Vetches wanted for sowing immediately after they are cut, may be threshed very well on a hurdle, with a cloth; though they may then be too soft, notwithstanding their being ripe, to be threshed on a floor, where the flail, and the thresher's feet, would bruise and break them.

When

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When a careful husbandman opens and spreads his sheaves, he will pick out of them at least all the largest and most apparent weeds, before he begins to thresh. As he proceeds in his work, he will, from time to time, remove all the long straw from the corn beaten out of it, which last always lies underneath, with a prong or fork; and then the pieces of straw, broken ears, &c. with a wooden rake. He will then shovel the remaining grain up on one side of the floor, and repeat this till he has threshed out enough to make what is commonly called a *clearing*.

This heap is then passed through a wide sieve, which retains only the bits of straw, and such fragments or ends of the ears as have escaped the flail. These frequently contain very good corn; though the farmer seldom grudges giving them to his poultry, or binding them up with straw intended for fodder. A few of them inclosed in a small truss bound at both ends, the better to keep them in, will entice horses to eat heartily of this straw, which affords them good nourishment: and Mr. Duhamel judges^a that they would also be excellent and profitable winter food for sheep, when there is a scarcity of grass.

A great deal of labour may be saved in the using of this sieve, by fastening a loop to it's rim, and resting it thereby on a hook suspended by a rope. This will sustain half the weight of the corn, and the winnower may easily give it the necessary circular motion. But a yet more convenient method, is to place a square sieve, of wire is best, with thin boards for it's sides, upon two polished rods of iron, to throw the corn up into it with a shovel, and to push it backward and forward

^a *Eléments d'Agriculture, Tom. I. Liv. 4. c. 3.*

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upon these rods, on which it moves easily, and will sift a great deal of corn in a short time.

For separating the chaff, which is the next business, the casting-shovel is much more expeditious than either the wicker fan, or the common winnow with sails. When this shovel is used, the wind must blow through the barn, either in at one door and out at the other, or in at a window and out at the opposite door. The winnower then, placing himself under the wind, and close to the heap of corn that is to be cleansed, takes it up, one shovelful after another, and, with a circular motion, throws it scattered in the air, against the wind, towards the opposite side of the barn. The best grains, which are the heaviest, go farthest; the lesser fall short of them; and the very small, shrivelled, and much damaged, with the seeds of cockle, darnel, and several other weeds, fall still nearer to the man who throws them; while the lighter seeds of other weeds, with the bits of straw, chaff, dust, &c. are blown from all the rest, by the wind. From time to time, the winnower quits his shovel, and sweeps away the second sized corn, which would be too much intermixed with the smallest, if the heap was left alone and suffered to accumulate till the end of the winnowing; and when the whole is done, he shovels up the finest grain. The least of all, which borders on the chaff, &c. is also then collected, and the three sorts, after being sifted or screened to cleanse them from any remaining dust, are laid up separately; the first for sale, the next for domestic uses, and the third, if the farmer can afford it, chiefly for the food of poultry. The short straws and chaff are sifted in a pretty fine sieve, to clear them likewise of dust, and are frequently given to oxen and cows.

Mr. Lisle observes, that the bad seeds cannot be separated from any grain by the common fan, but
that

that it may be done with the screen, of which he therefore advises the constant use for all sorts of corn designed for sowing^a.

Though wind is, in all cases, the chief agent in the cleansing of seeds, which being intrinsically heavier than their coats or husks, are, by the same force applied to both, carried to different distances, in proportion to their weight, and thereby consequently separated; yet the natural action of this assistant is liable to many inconveniences: it blows not constantly; but frequently disappoints the winnower in his time of greatest need: when it does blow, it is not always in the best direction to answer the situation of his barn; and without doors it is entirely useless to his purpose, if it be not attended with fair weather. Besides, when it's force can be applied in the best way, it is even then not equal; but generally acts by sudden blasts, which, as is well known, disorders the whole work, and occasions a considerable waste of seed^b.

The Dutch avoid these inconveniencies by using a machine (*PL. II. Fig. 1.*) which creates an artificial wind, uniform and steady in it's action, and always ready at command.

The Fan (*Fig. 2.*), which is the acting part of this engine, produces a wind proportioned to the velocity with which it is turned on it's axis, and therefore capable of several degrees of strength, as best suits the purpose of the winnower.

This fan is inclosed in a large case or box, *KL*, and occupies one half of it; which is represented separately, and in a different view, in *Fig. 3.* It is suspended freely on it's axis, and turned by the handle *A*. The other half of the box is empty, and receives the seed as it falls down from the hopper *B*, to the sloping floor visible at *C*, along

^a *Observations in Husbandry, Vol. I. p. 348.*

^b *DUBLIN SOCIETY'S weekly Observations, No. 39.*

which it slides out at *D*, while the force of the wind which is confined within this winnow, and always acts in the same direction, *viz.* lengthways of the machine from *A* to *E*, carries the chaff, light and rotten grains, dirt, &c. out at *E*. In this passage, the wind meets the seed constantly falling from the hopper, and impels it more or less toward the end *E*, according to it's weight. Good seed never goes quite so far, but comes down within the box.

The hopper here is ingeniously contrived to save labour. It hangs by strings upon four pegs, and moves with such ease, that the necessary motion may be communicated to it by the same hand that moves the fan, without any hinderance to the workman. To this purpose, a triangular board *f*, is fixed upon the handle of the fan, and turns with it. The angles of this board, in their rotation, press against the lower end of a little lath, incurvated as in the figure, which moves freely upon a peg at *g*. This end accordingly recedes from the pressure towards *H*, and consequently the upper end moves the contrary way, towards *I*, and by a string fastened from it to the hopper, draws this last after it, out of it's natural situation. When this pressure ends, and the sides of the little triangle are next to the lath, the hopper hangs freely, returns to it's former place, and takes the lath along with it, till the next angle of the little triangle begins to act; and so alternately as long as the fan moves. As the hopper is thus in continual motion, the seed sheds down, and is winnowed as it falls.

The next care is to cleanse the corn from all foreign bodies which could not be carried off by the wind, such as stones, bits of earth, &c. These are separated by running the grain through a sieve wide enough to let it pass with ease, while bodies of a larger bulk are retained: and it is likewise

likewise often necessary afterwards to use a fine sieve which lets through only the dust, seeds of weeds, and other bodies smaller than the corn.

Though we, happily, in this kingdom, are not under the same necessity as some foreign countries, of building large edifices for public granaries, because our harvests are much less apt to fail us; yet as this work is, perhaps too presumptuously, intended for general use, it is incumbent on me to speak of those effectual, though expensive means of guarding against dearth, or even famine, as well as of the cheaper and easier methods, by which every farmer may be enabled to enjoy the advantage of preserving a large quantity of corn in a small space, without danger of it's heating and fermenting, of it's being preyed upon by destructive animals and insects, or of it's being spoiled through the ignorance, or want of judgment, of inattentive servants.

Corn reaped in a dry year, and especially that of the growth of a hot country, is well known to be the most perfect, and the fittest for keeping: as, on the contrary, experience has proved that the softer and less ripened grains of wet years and rainy harvests should always be disposed of for more immediate use, though their too great humidity, which would infallibly occasion a putrefaction, if not remedied in time, may be exhaled, and they may then be preserved a long while in very good condition, as will be shewn from repeated facts and proper experiments.

The ancient Romans imported annually vast quantities of corn from Egypt, a very hot and dry country, scarcely ever watered but by the periodical overflowings of the fruitful Nile; and they found this grain answer much better than any of their own growth, both for yielding plentiful crops, when sown in Italy, and for keeping in their public granaries, where they frequently preserved it many

years, perfectly sound. Pliny tells us^b, that, in his time, they kept corn a long while in subterranean caverns, made in a dry soil, and so closely stopped that not a breath of air could enter. They then covered the bottom with straw, and laid upon that the corn in the ear. We have the concurrent testimony both of the ancients and moderns, that it will keep thus perfectly well for at least six or seven years; and an accident, not long ago, discovered a parcel of corn thus preserved at Amiens, where, though it had been laid up during a great number of years, it was found to be fresh and good, neither worm-eaten, rotten, nor mouldy. This was certainly owing to the moist air having been kept out, and with it the eggs of animals, and seeds of those minute vegetables which we see in form of mouldiness on such corn as has been less carefully defended from their access. In effect, experimental philosophy has proved, that the air is the great source of corruption; for even the most corruptible substances, such as meal, butter, milk, and the like, have been preserved fresh four months in the exhausted receiver of an air pump.

There still is, near Grand-Cairo, a vast subterranean magazine of corn, defended with good walls, and called Joseph's granaries. It is hardly to be supposed that they are quite so old as the days of that patriarch: but they abundantly prove the utility of such places of store, by the vast quantities of grain annually preserved in them.

Many parts of Africa, the corn of which country, and particularly that about Algiers and Tunis, will keep much longer than the growth of any other place, abound with granaries of this kind. They are deep pits made in the solid rock, but just wide enough at their top for a man to go down into them,

^b *Lib. XVIII. c. 30.*

but they grow larger immediately after, and are usually squares of from thirty to forty feet in diameter. In these, the great men of the country preserve their corn. They first cover the floor with straw, then spread upon that a layer of corn, upon this another, but thin, bed of straw, then another couch of corn, and so on, till the whole cavity is filled; observing all the while, as the heap rises, to place straw between the corn and the sides of the walls. When this is finished, they cover the mouth of the entrance with a sort of hurdle, over which they lay about two feet thick of sand, and over this they raise a ridge of earth, well beaten together, in order to throw off the rain both ways, that none may settle on the place and soak into the magazine. The corn thus stored up always keeps three, four, or more years, very sound; and not unfrequently, the proprietor being taken off by the cruel despotism of the Eastern governments, the magazine is forgotten; some accident discovers it many years afterwards, and the corn is almost always found perfectly good in it. All the care they take, by way of preparing the grain, is to expose it two or three days to the heat of the sun, to dry it thoroughly before they carry it into the magazine.

In the dutchy of Lithuania, and in the Ukraine, the people always preserve their corn in nearly the same manner, in wells or pits made in dry places: but great care must be taken there in the opening of these stores; for people who have descended into them, before they had had sufficient communication with the fresh air, have been killed by the damps^a.

The Russians too preserve their corn under ground, in deep pits of almost the figure of a su-

^a DES LANDES, *Trait. Phis.*

gar loaf, wide below, and narrow at top. The sides are well plastered, and the top is covered with stones. They are very careful to dry their corn well, generally by means of ovens, kilns, or stoves, for their summer is too short to effect it sufficiently, before it is laid into these repositories.

The same thing is practised with unvaried success in the island of Malta; and also in Gascony, the Vivarais, and other southern parts of France, the corn of which is remarkable for keeping many years longer than that of any other province in the same kingdom. M. Duhamel tried this method in the Gatinois: but his corn was soon spoiled there by it's humidity when laid up; that country being subject to wet and moisture, and his grain, in this trial, not having been previously dried in an oven or stove^b,

Upon the whole, it is evident from these, and from many more instances, which might be alleged, of the practice of other countries, that subterraneous granaries properly made in a thoroughly dry soil, are the best of all repositories for the keeping of corn: but, at the same time, experience shews that this method will not succeed in our climate, the sun here not having power to exhale the moisture from the corn, sufficiently to prevent it's fermenting when laid in a large heap. I must likewise add, that when one of these subterranean magazines is opened and exposed to the air, it must be emptied immediately, and the corn taken out of it must be thoroughly sifted and screened, or it will soon corrupt. Some think it more nourishing, when it has been well preserved, than that which has been kept in granaries above ground.

The Marquis of Santa Cruz, author of many excellent remarks on the political and military state of different nations, observes, that the corn

^b *Elements d'Agriculture, Tom. I. Liv. 5. c. 3. Art. 1.*

of Galicia and the Asturias will hardly keep from one year to another, because of the humidity it contains, which rots and decays it; but that the corn brought thither from Castile will keep good many years. This last is therefore the only kind that the Spaniards ever venture to lay up in their public granaries: and the sole difference, in M. Des Landes's opinion, between it and their other sorts, is, that it grows in a country where there is less rain in summer. They might indeed, if their religion and policy did not forbid their having intercourse with the moors of Barbary, once their conquerors, easily import from Africa plenty of some of the best corn that the world affords, perfectly ripened, thoroughly dried, and, in all respects, fit for keeping many years.

The great objection to public granaries, even in countries where the uncertainty of the climate, the indolence of the people, the ill-judged form of government, and various other causes frequently combine to render them highly necessary, is the expence attending such establishments; generally so great, that none but a monarch, or a state, can properly undertake them; and they, most certainly, cannot do any thing more laudable, more truly noble, in countries whose misfortune it is to be exposed to the dreadful calamities of want and famine, or to depend upon the precarious assistance of their neighbours.

Though subterranean repositories for the keeping of corn are preferable to all others in countries proper for them; yet even the common granaries may, with due care, and perhaps some few alterations, be rendered much more serviceable than they generally are. The principal cautions necessary to this purpose are, 1, to guard against the

too great humidity which always prevails in places where there are many doors and windows: 2, to prevent a too free access of the external air, because this brings in with it the eggs of a vast number of different insects, which prey upon and destroy the corn: and 3, to take care that the corn be thoroughly dry, and as clean as possible, when it is laid up. These are the three general rules to prevent it's corrupting.

The chief cautions to be observed in the erecting of granaries are, to make them sufficiently strong, and to expose them to the most drying winds. Sir Henry Wotton and Mr. Worlidge agree particularly in these; both judiciously advising a northern aspect for these buildings, because that quarter is coolest and most temperate; and the latter rightly observing, in general, that the best granaries are those built of brick, with quarters of timber wrought in the inside, whereto to nail well joined boards so closely to the wall, that there be no room for vermin to shelter themselves. Floors of plaster are reckoned the best, because they are cool in summer, and, if well made, do not retain dampness in the winter. There may be several stories one above the other; for the shallower the corn lieth, the better it will keep, and the more easily it is turned. Some have a small hole in the floor of their upper granary, through which the corn descends into the lower one, like the sand of an hour-glass; and after it is all come down into the lowest granary, it is conveyed back into the upper one; so that it is kept in continual motion, which is a great means of preserving corn.

The granary in the city of Schönbank, in the vale of Parinburg upon the river Elbe, which is a store-house for the wheat of which the mum is made at Brunswick, is built nearly in this manner.

It

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It is three hundred feet long, eighteen feet wide within, has seven stories, each of which is seven feet high, and large windows all around, to open and shut close according as the wind fits. By this means, the dross and dust are carried off as the corn is turned; for which a west wind is always preferred, because it is the driest. At each end of this granary, and in the middle, are stoves for fire in damp weather, and at the going away of great frosts and snows, to prevent moisture. There are also on each side of this building three long troughs or spouts, in the upper loft; and in fair weather men throw the corn out of this loft into those spouts, through which it falls into others, about ten feet wide at the top, and eight or ten inches at the bottom, by which it is conveyed into the lower story, from whence it is wound up again by a crane fixed in the upper loft. By thus falling from one story to another, the corn is cleansed by the wind from all dust and chaff, and receives the benefit of the air, &c. These troughs, or spouts, are put on and taken off as occasion requires, to any of the windows; that when vessels come to lade corn, it may be conveyed, through them, into the proper barges, without being carried thither by men, or cattle. The wall of the two first stories is two bricks and a half thick, that of the three next is two bricks thick, and the thickness of the two uppermost is a brick and a half. Fourteen thousand quarters of corn may be kept in this granary.

Mr. Mortimer, who gives us this account, which is taken originally from captain Andrew Yarranton's *England's improvement by sea and land*, adds, that the ears of corn, cut off from their stalks, and packed up close in a tight cask, will keep very well, and that this is the best, he

indeed says, the only way of carrying any sort of corn over the sea, in order to sow it in a foreign country ^d.

The public granaries at Dantzick are seven, eight, or nine stories high, and have a funnel in the middle of every floor, to let down the corn from one to another. They are built so securely, that the corn does not contract any damp, though they are surrounded with water on every side, in such manner that vessels come up to the very walls for their lading, which is let down into them, likewise through pipes or funnels, with very little labour and charge. No houses are suffered to be built near them for fear of accidents by fire ^e.

At Zurich, in Swisserland, corn is kept eighty years, or more, in the public granaries, which are very spacious, and well aired by means of many square wooden pipes which pass through them.

The twelve companies of London, with some other companies and private persons, had formerly their granaries at the Bridge-house in Southwark, under the superintendance of a justice of the peace, a steward and two masters. These granaries were built on two sides of an oblong square (now used for a wharf), one of which stood north and south, and was near an hundred yards long. Along this side were lattice windows which faced the north-east; and on the other side, which was about fifty yards long, the windows looked to the north. The opposite side had no apertures. All the windows were about a yard high, without any shutters, and ran on in a continued series, with very small partitions, sufficient only to nail the lattices to. Each of these granaries was three or four stories high; but the lowest, or ground story,

^d *Art of Husbandry*, Vol. I. p. 146.

^e *Philosoph. Trans.* No. 25.

which

which was twelve feet high, was used only for a ware-house.

In Kent, two square holes are made at the end of the floor, and a round one in the middle, by means of which the corn is thrown from the upper into the lower rooms, and back again, the better to turn and air it. The screens used on this occasion are made with two partitions, to separate the dust from the corn. The dust falls into a bag, and when this is sufficiently full, it is thrown away; the pure and good corn remaining behind. By these means corn has been kept thirty years in this country: and it is observed that, the longer it is kept, the more flour it yields in proportion, and the purer and whiter the bread is; only the superfluous humidity evaporating in the keeping; for grain does not diminish in weight or bulk, after the first year.

The usual way of preserving it in our common granaries is, after it has been well sifted and screened, to spread it upon the floor about six inches thick, to turn it twice in a week, and to repeat the screening of it once a week, during the first two months. It is then laid a foot thick, for two months more; and in this time it is turned once a week, or twice, if the season be damp, and now and then it is screened again. At the end of five or six months, it is raised to the thickness of two feet, turned once a fortnight, and screened once a month, or as occasion requires. After a year, it is laid two feet and a half, or three feet deep, turned once in three weeks or a month, and screened in proportion. When it has lain two years or more, it is turned once in two months, and screened once in three, and how long soever it is kept, the oftener it is turned and screened, the better the grain will be preserved. An empty space, about two feet or a yard wide, is always left
on

on each side of the corn, to prevent it's running down holes or chinks at the edges of the floor, and to remove it from all moisture that may proceed from the sweating of the walls, or from any defect in the roof; and another space is commonly left along the middle of the heap, if it be a wide one, to facilitate the turning of it as often as is needful. This is the general custom; and experience has shewn it to be necessary in the usual manner of keeping grain.

But all the foregoing methods of preserving corn in granaries above ground are attended with very great expence, by reason of the vast buildings, which they require, and the many servants necessary to be employed to take care of these stores: besides which, too much depends here upon the assiduity, skill, and probity of those servants; and the grain is still liable to be preyed upon, wasted, and spoiled, by vermin and insects.

To obviate these inconveniences, and to point out an easier, cheaper, and surer way of keeping all sorts of grain, is the principal design of M. Duhamel's excellent treatise on the preservation of corn; in which, after rightly noticing the several disadvantages attending the common practice, he proposes a method founded in reason, and on his own repeated experience, as well as that of others, whereby a large quantity of corn may be preserved in a small space, during a number of years, without danger of it's heating, fermenting, or contracting a bad smell or taste, and secure from the spoil of animals and insects, at a trifling expence, and with very little trouble*. All these
desireable

f Ibid.

* The reverend, and truly worthy, Dr. Hales, ever studious to promote the welfare of mankind, proposes the following method of preserving corn, as a means which may be very
beneficial

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desireable ends may be obtained, in some cases, by ventilation only; in others, by drying the corn in a kiln, oven or stove; and in others again, by both these methods; as will appear from the following experiments. But, previous to them, it will be right to give a short

Description of M. Duhamel's Granary of Preference for the subsistence of a middling family^a, from which we may form a just idea of what is requisite for larger uses.

Fig. 4.

beneficial to the poor, who keep only small quantities of it in sacks.

"Provide a red-cane, or other hollow stick, made so by glueing together two sticks grooved hollow: let it be about three feet nine inches long; and, that it may be the more easily thrust down to the bottom of the corn in the sack, let its end be made taper to a point, by fixing therein a wooden plug, which will at the same time stop the orifice at that end. About an hundred and fifty small holes, of one eighth of an inch diameter, are to be bored on all sides of the stick, from its bottom, as far as two feet ten inches of its length; but no nearer to the surface of the corn, lest too great a proportion of air should escape there. By wreathing a pack-thread in a spiral-screw like form round the stick, the boring the holes may be the better regulated; so as to have them about half an inch distant towards the bottom, but gradually at wider distances, so as to be an inch a sunder at the upper part; by which means the lower part of the corn will have its due proportion of fresh air. To the top of the stick let there be fixed a leather pipe ten inches long; which pipe is to be distended by two yards of spiral wire coiled up within it. Or a tin pipe may be fitted to it for the same purpose, having a piece of leather fastened to the other end, to receive the nose of the bellows. At the upper part of the pipe is fixed a taper wooden faucet, into which the nose of a common household bellows is to be put in order to ventilate the corn.

"If corn, when first put into sacks, be thus aired every other or every third day, for ten or fifteen minutes each time, its damp sweat, which would hurt it, will, in a few weeks be carried off to such a degree, that afterwards it will keep sweet with very little airing, as has been found by experience.

"By the same means many other kinds of seeds, as well as corn, may be kept sweet, either in sacks or small bins: but

^a *Traité de la Conservation des Grains*, p. 196.

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Fig. 4. and 5, PL. II, represent this granary, which is only a common vat, well hooped, either with wood or iron, and joined as closely as if it were to contain liquor. The bottom is strengthened and supported by the joists *a*, which cross the seams, and are cut down at their ends, so as to lie close to it; and around the inside top of the upright staves is a groove *b*, *Fig. 4.* to receive the boards or staves of the cover *c*, *Fig. 5.* When the upright staves, which form the sides of the vat, are too thin to admit of this groove, a wooden hoop may be nailed on, so as to answer the same purpose: and to strengthen the cover, upon which it may sometimes be necessary for a man to step, two pieces of wood, about two inches and a half or three inches thick, marked by pricked lines in *Fig. 5.* are fastened under and across the boards *c*, in which are several holes or openings *d*, of four or five inches diameter, to let out the air when the bellows are worked: but at other times they are closely stopped with bungs (*e*), to prevent the entrance of any creature whatever. A second bottom of lattice-work, of wood, covered at top with strong canvas, or hair cloth; or, which may be yet better, because the dust will be more easily shaken out of it, a wicker bottom closely woven, should be fitted exactly to the breadth of the vat, and rested upon joists, so as to leave between it's upper surface and the lower bottom, a space of about four inches and a half in height, for wind to be distributed throughout: for, as it is well known that corn laid up in any considerable heap, especially in countries where the air is not perfectly dry, will soon ferment and spoil, and that this is

for bins, the air-holes must be made only near the bottom of the canes, because all the air must in that case ascend upward, since it cannot go through the sides of the bin, as it will go through sacks."

best

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best prevented by forcing out the tainted air, and supplying it's place from time to time, with fresh; or, in other words, by establishing a current of air, which shall pass through the corn, and carry off the dampness; so the grain deposited in this vat, or granary, must be ventilated at proper intervals. To this end, the common nose (*i*) of two small bellows (*b b*), or that of a single larger one, is to be so fixed between the two bottoms of the granary, by an opening made for that purpose, as to convey forcibly into it the air received from without. One man may easily work these bellows by means of the lever *l*: but even that labour may be saved, and when the granary is large it will undoubtedly be most adviseably, by working it with swifts, like those of Dr. Hales's ventilators. The best bellows for this purpose are likewise those contrived by that excellent patriot; because they are constructed without leather, or any matter liable to be destroyed by vermin. The vent-holes at top, out of which the air is forced, after being driven through the whole body of the corn, may, besides their other stopples which are to be taken out at the time of ventilating, be covered with a close wire-lattice, for farther security against vermin.

M. Duhamel calculates^b, that every stroke of a large pair of bellows conveys two cubic feet of air into the granary, which, at the rate of 420 strokes in five minutes, will supply 80640 cubic feet in eight hours working.

The proportion of air in a heap of corn is found to be about one eleventh part: but supposing it even a third, the whole will be changed 2600 times in eight hours, with only one pair of bellows.

^b *Ibid.* p. 37.

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To these computations the same ingenious gentlemen add another, extremely interesting, relative to the difference in point of room, as well as of expence, between his and the common granaries. He supposes one of these last 80 feet long and 21 broad, which makes a surface of 1680 feet. From this must be taken off, for the passage and the sloping of the corn, at least three feet on each side, which makes six feet for the whole length, or 480 square feet. There consequently remain but 1200 feet: and as at least fifty feet more must be deducted from this, for the space necessary for turning the corn, and for the passage at the other end, the room actually occupied by grain will be 1150, which, at the medium depth of eighteen inches, will contain only 1725 cubic feet of corn. Now one of his granaries of twelve feet cube will contain 1728 cubic feet of corn: and as to the saving in the expence, it is self-evident.

It is quite immaterial whether these granaries of M. Duhamel's invention are round or square. If the latter, they must be made of sound oaken planks, at least two inches thick, or more, according to their dimensions, and great care must be taken to join them very close. The vent holes, double bottoms, and manner of applying and working the bellows, are the same.

It is of great importance that the corn be well cleaned before it is put into one of these granaries of preservation, as M. Duhamel calls them; because it must continue there till it is made use of. The sieves, screens, and winnows before mentioned, do very well in the common way, for corn that is not to be kept a long while, or in this manner: but much nicer cleansing is necessary here; and, above all, great care must be taken to guard

Fig. 1.

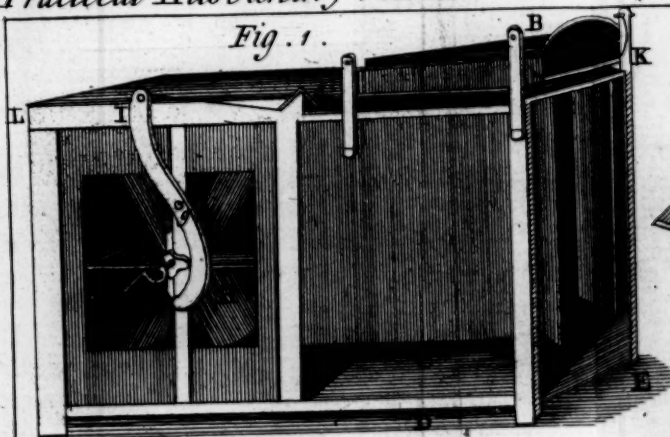


Fig. 5.

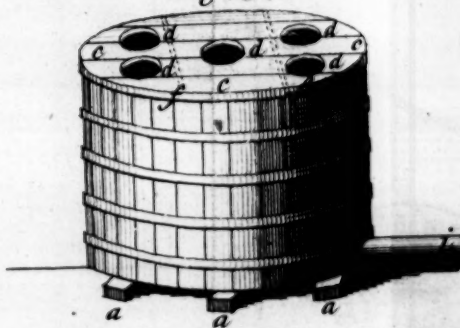


Fig. 4.

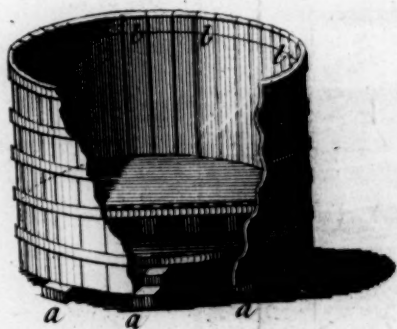


Fig. 2.

Fig. 3.

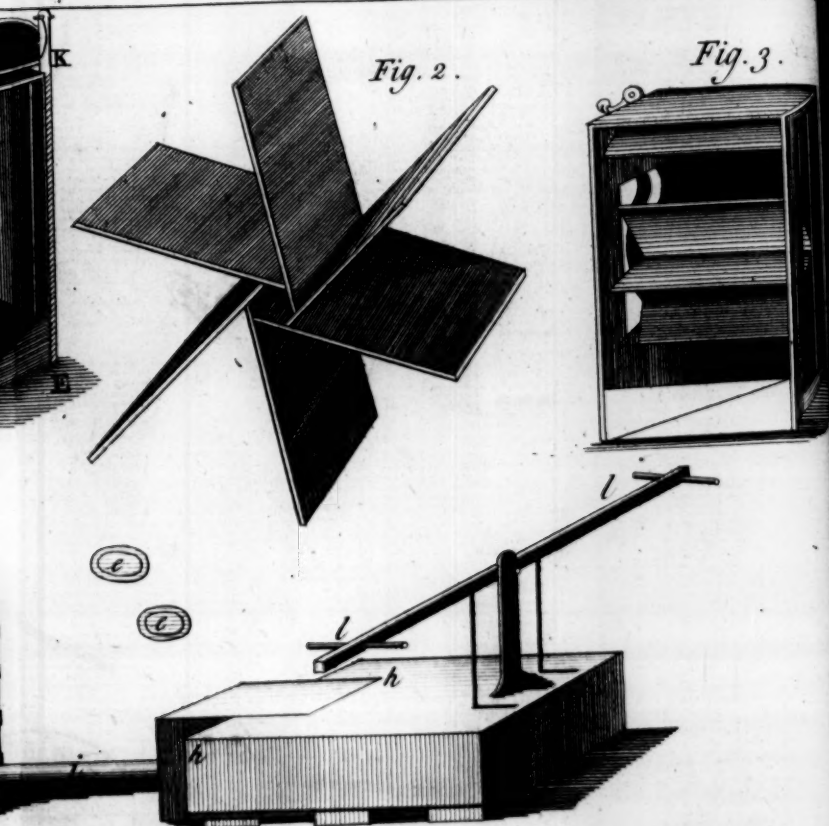
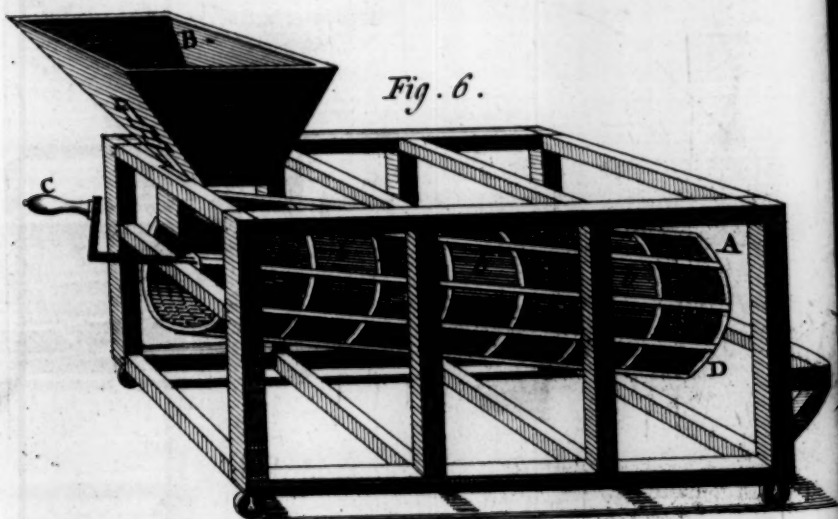


Fig. 6.



against the least mixture of smutty grains. It will therefore be right, before the corn is thus laid up, to purify it thoroughly from all remaining dirt, dust, chaff, and insects not actually inclosed in the grains, if any such there be, by passing it through the following cylindrical or bolting sieve, which may also be used very advantageously for the same purpose, on other occasions, especially when the corn is fouler than usual.

A, Plate II. Fig. 6. is a cylinder ^d like the bolter commonly used for sifting meal, excepting that it is stronger made, of a larger diameter, and, instead of linen, is covered with alternate circular rows of tin (*a*) and wire (*b*). The tin is punched through, so that it's inside is like a nutmeg grater, and the wires are laid parallel to each other, as in a screen.

The corn is put into the hopper *B*, from whence it runs into the cylinder, which is raised a little at the end next to the hopper. The cylinder is turned with a handle *C*; and its slope makes the corn glide by degrees to the other end *D*, where it falls out. This sieve, like the common bolters, is entirely covered with a cloth, to hinder the dust from mixing with the good grain.

The corn, in its motion here, is rubbed so strongly against the rough edges of the holes in the tin, while the dust and small grains drop through the wires, that it is of a far brighter, clearer, and better colour when it comes out at the opposite end *D*, than it was when put into the hopper.

This sieve is particularly excellent to cleanse mildewed, smutty, or spotted corn: but the grain must sometimes be passed through it pretty often,

^d *Ibid.* p. 106.

it be very foul, before it be rendered quite clean.

As the following experiments shew how far, and in what cases, either ventilation, or the use of fire, singly, or both of them jointly, may be effectual to preserve corn; and likewise how far either, or both of them will destroy the insects most apt to prey upon it in the granary, particularly the moth and weevil; I shall only observe here, that kiln-drying, or drying in an oven, will answer all the ends of M. Duhamel's stoves, at a much easier charge; and that they are sufficient for this, or any other country, where the harvests are not precarious. The curious who can afford to be at the expence of such stoves, may find correct drawings, and an accurate description of them, in his treatise on the preservation of corn ^e, and in his *Elements of Agriculture* ^f.

That corn may be dried perfectly well in an oven, that it may be dried there to whatever degree is necessary in order to exhale the moisture which is a principal cause of it's corrupting, and that the same means will also kill any insect in it, appears from various parts of the preceding instructions and experiments of Messieurs Duhamel and Tillet, for destroying the corn-caterpillar in the province of Angoumois ^{*}: and as to the kiln, Mr. Tull instances [‡] a neighbour of his in Oxfordshire, who acquired a large fortune by drying his wheat on a hair cloth, in a malt-kiln, with no other fuel than clean wheat-straw, the heat of which he never suffered to exceed that of the sun. The longest time he let it remain in this heat, was twelve hours; and the shortest time,

^e Page 119 — 194.

^f *Tom. I. Liv. 5.*

^{*} See p. 73 — 93.

[‡] *Horse-hoeing Husbandry*, p. 131.

was about four hours. The damper the wheat was, and the longer intended to be kept, the more drying it required; but how to distinguish nicely the degrees of dampness, and the number of hours necessary for its continuance in the kiln, was an art, said the farmer, impossible to be learnt by any other means than practice.

Corn, though seemingly dry, contains a great deal of moisture, as is evident from its marking at least the floor on which it has lain, and as M. Duhamel experienced very sensibly, when, having put new corn into glass bottles well stopped, the moisture that came out of it appeared on the inside of the bottles, and the grain grew mouldy^b. We have also here a manifest reason why, let the weather be never so hot at harvest, the uppermost sheaves of a heap are harder to thresh than those which lie at the bottom. This is evidently the consequence of moist vapours that rise from the corn. Again, if a large heap of corn is laid up in a granary, and not stirred for a considerable time, or if only a barrel be filled with it; after some time, upon running one's hand into it, one will feel a sensible heat, with a small moisture: it next acquires a vinous smell, then turns sour, and at last mouldy; in short, it ferments, and is no longer fit to make bread, and sometimes even the fowls will not eat itⁱ.

This moisture must therefore be removed before corn can be laid up with safety, for any length of time: and as the sun has not power to exhale it in a climate like our's, recourse is to be had to fire. The weight of the corn is indeed considerably diminished hereby; but its vegetative power need not be at all impaired, as several facts mentioned in the foregoing account of the corn

^b *Traité de la Conservation des Grains*, p. 18. ⁱ *Ibid.* p. 21.

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caterpillar have proved, and as it is farther evinced by the following.

In the autumn of the year 1745, M. Duhamel weighed a quantity of wheat of the preceding harvest, and exposed it for twelve hours to the heat of a stove which made M. de Réaumur's thermometer rise to 50 degrees (123 of Fahrenheit's)*: it lost an eighth of it's weight, and yet was only dried; for, being sown, it came up.

He likewise put some wheat of the harvest of 1744, and spring corn of the harvest of 1742 †, in a stove heated so as to raise M. de Réaumur's thermometer to 38 degrees (101 of Fahrenheit), which, says M. Duhamel, is eight degrees of Réaumur's (15 of Fahrenheit's) higher than it rises in our very hottest summers ‡. Both the sorts of corn used for this experiment lost a two and thirtieth part of their weight in twenty four hours. They were put again into the stove heated to 51 degrees of Réaumur's thermometer (125 of Fahrenheit's), and their weight was diminished very near one sixteenth in twenty four hours. Other parcels of wheat, some old, and some new, were dried, purposely to try what degree of heat would destroy it's power of vegetating. Some underwent a heat of 12½ degrees of Réaumur's thermometer (54 of Fahrenheit's) some 38 (101 of Fahrenheit), and some 51 (125 of Fahrenheit). In all these cases, the new came up, but the old did not^k,

* This is a height to which the liquor of a thermometer scarcely ever rises when exposed to the hottest sun, *Conservation des Grains*, p. 18. note a.

† The corn of both these crops was housed very dry. *Ibid.* p. 19. note c.

‡ When the thermometer is set in a shady place, as it generally is for the making of observations, *Ibid.* p. 19. note d.

^k *Ibid.* p. 20.

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In general, it certainly is most advantageous to unite the kiln-drying and ventilation, not only because they are most effectual to preserve corn, when joined together, but also because they are then least costly and least troublesome: for, to kiln-dry, and much more to stove-dry, it sufficiently to keep without ventilation, requires a great deal of fire and much attendance; and to preserve it without kiln-drying, will require very frequent ventilation; whereas, by joining the two methods, both are rendered very easy and less expensive, and the success is more certain.

EXPERIMENTS ON THE PRESERVATION OF CORN BY VENTILATION ONLY; *with remarks thereon.*

M. DUHAMEL¹ caused a case, or little granary of preservation, to be made of oak plank two inches thick, forming a cube of five feet every way. At six inches from the bottom was a flooring, or second bottom, of lattice work, placed upon joists five inches thick, and covered with a strong canvas, in the manner before described^m. This small granary was filled quite full of good wheat, of which it contained 94 cubic feet, weighing 5040 pounds. It was covered with good oak planks, so closely joined, that neither rats, mice, or even the smallest insects could get in; leaving only some vent-holes, with trap doors, or covers, fitted very exactly to them, as mentioned beforeⁿ.

This corn, laid up without having been dried at all by fire, was not ventilated more than six days in a year, which was sufficient to keep it so well, that the best judges allowed it to be as good

¹ *Traité de la Conservation des Grains*, p. 26.

^m Page 116.

ⁿ Page 117.

as could be. Even when the bellows had not been worked for several months, the corn was still allowed, by good judges, to look and smell perfectly well: but they objected, that it did not handle well, that is, that there was some little dampness in it. The bellows were worked for half a day, and this objection was entirely removed.

Remark. This wheat was old, and had been as well dried as any corn generally is in a common granary: therefore it's being still damp, at the end of a considerable time, shews the necessity of taking away the superfluous moisture, and of reducing our corn to the same degree of dryness, as that of the hottest countries, in order to preserve it in great bodies°.

Experiment on 94 cubic feet of Wheat.

In May, 1743, ninety four cubic feet of wheat were put into one of the little granaries before mentioned^p. It was of the harvest of 1742, of an excellent quality, perfectly clean, and so dry, that a small parcel of it which was put, for a trial, into a stove heated to 50 degrees of M. de Réaumur's thermometer (123 of Farenheit's) lost but one sixteenth of it's weight. This wheat was well cleansed from dust, and deposited in the granary without being dried by fire.

During the first three months, it was ventilated for eight hours once a fortnight: during the rest of the year 1743, and all 1744, it was ventilated once a month: all the year 1745, and part of 1746, it was ventilated half a day once a month; and after that, but once in two or three months.

° DUHAMEL, *ubi supra*, p. 53. ^p *Id. ibid.* p. 56.

In June 1750, the granary was emptied, and the wheat looked and smelt very well, but felt a little rough in the hand; because, not having been stirred for six years, the little hairs that are at the extremity of the grain, and the particles of the bran, were roughed up: but after passing twice through the wind screen *, that objection was entirely removed.

Remark. This corn was eight years old, during seven of which it was preserved in one of M. Duhamel's small granaries, without any sensible diminution, and without any damage from vermin or insects: I cannot say absolutely, without any expence, because a man was employed from time to time to ventilate it. But this was a very trifling charge, and may be reduced almost to nothing, by working the bellows with swifts like those of a mill.

Experiment on 75 cubic feet of new wheat, extremely moist, grown, and which had already contracted a bad smell.

The harvest of 1745⁹ was very rainy: almost all the wheat of that year was grown in the ear; the sheaves were extremely wet when they were housed; the grains adhered so closely to their husks, that they were greatly bruised by the flail; and if they were left but a very little while upon the barn-floor, before they were cleansed, they heated, and contracted a smell like that of pigeon's dung: in short, they were so very moist, that they lost an eighth part of their weight when dried in a stove heated to 50 degrees of M. de Réaumur's

* The screen described in p. 103, of this Volume, or the cylindrical sieve in p. 119. will answer this end equally well.

⁹ *Traité de la Conservation des Grains, par M. DUHAMEL, p. 63.*

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(123 of Farenheit's) thermometer; and when laid up in the common granaries, in the usual way, they were always in a state of fermentation, though but a foot thick, and turned every fourth or fifth day.

Seventy-five cubic feet of this grown wheat, which smelt very ill, and was so moist as to wet the floor of the granary where it laid but a few days, were put, in this condition, and without being dried by fire, into one of M. Duhamel's little granaries, with small hopes of success.

As this corn was very hot when put into the granary, it was ventilated three or four times the first week, and once a week during December and January: and as it had then lost great part of it's bad smell, it was ventilated but once a fortnight from that time till June. Then perceiving, by thrusting his hand into the top of the heap, that it heated, and concluding that it was going to be entirely corrupted, M. Duhamel ordered the granary to be emptied: but after the depth of about a foot had been taken from the top, he was greatly surpris'd to find the rest cool, with very little bad smell, and drier than that which was preserved in the common granaries.

Remarks. The reason why the top of this corn was the worst, was, undoubtedly, that the moist vapours were always forced upwards in ventilation.—It therefore might, perhaps, have been kept very well, if, instead of emptying the granary, it had been ventilated oftener: for this would, probably, have dried away the remaining moisture, even at the top, as the following experiment will shew. But however that might have been, this teaches us one important thing, which is, that the top of the heap is most subject to heat in this sort of granary: so that if the grain taken out of the vent-holes is in
good

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good condition, it may be concluded that the rest is still better.

Experiment on 555 cubic feet of Wheat, very damp, mixed with smut, and which had contracted a bad smell.

The wheat of the year 1750 grew in almost continual wet; the harvest was very rainy; and the same weather continuing all the year 1751, no pains that could be taken to turn the corn laid up in the common way, could dry it, or prevent it's heating and contracting a bad smell. The wheat of this crop was likewise mixed with a considerable quantity of blighted and smutty grains, which always contain a great deal of moisture, doubly difficult to be exhaled from them, and which soon makes them contract a bad smell, which they speedily communicate to the sound corn.

Five hundred and fifty five cubic feet of this wheat were deposited in one of M. Duhamel's granaries of preservation, after being cleansed with such perfect care, that scarce any mark remained either of blight or smut among it; though these faulty grains amounted to near a sixth part of the crop. But there still remained a fine dust, or powder, occasioned by the moisture, so closely adherent to the corn, that it could not be taken off by any means.

This wheat was laid $4\frac{1}{2}$ or 5 feet thick in one of these granaries, the bellows of which were worked by a wind-mill; and as there was no want of wind during all the year 1751, and till the spring of 1752, the corn was often ventilated, without trouble or expence; by which means it was not only well dried, but also cleared of great part of it's bad smell. It was indeed, when taken out of the granary, very full of dust which had fallen

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fallen off the grains as their moisture was exhaled: but this was then easily separated by proper screening, and the wheat proved so good, that the bakers bought it at the highest market price.

Remarks. This experiment proves, that even very moist corn, which has a great disposition to ferment, may be preserved by ventilation only: and as to the smutty grains with which this was mixed, the reverend Dr. Hales, after rightly observing that kiln-drying is apt to make wheat grind unkindly, proposes the following method of drying smutty corn, after it has been washed; cold air not hurting it, as kiln-drying is found to do. " That I might be well assured, says that friend " to all mankind, of the good effect of thus drying smutty corn; having procured a quantity " of very smutty wheat, which weighed seven " pounds and fifteen ounces, on the twenty-sixth " of May, at five in the morning, it was washed " clean in four several waters, which was done in " a few minutes, and was then laid to drain in " an oat-sieve, till half an hour after five, when " it had increased in weight, by wetting, ten " ounces, besides the moisture that was equal to " the weight of the smut-balls and smut that was " washed from the wheat. It wasted but two " ounces and an half by the first two hours ventilation; two ounces and five drachms in the " second two hours, viz. from eight to ten; in " the next six hours, viz. from ten to four in the " afternoon, it wasted at the rate of four ounces " every two hours; from four to six, two ounces " and an half, and from six to eight, one ounce and " an half: in all, about twenty ounces; some allowance being made for what corn was wasted by " handling and biting some of it from time to time. " It was ventilated in these fourteen hours with " about forty thousand gallons of air, which " passed upwards through it, and made it sufficient-
" ently

“ently hard and dry, so as to be fit for grinding :
 “it was well coloured, and handled well ; and,
 “from stinking, as smutty wheat does, it be-
 “came much sweeter. The visible dewy moisture
 “was blown off in three hours ; but it continued
 “damp and cold to the feeling till two o’clock,
 “when some little dust began to fly off it.

“And whereas it wasted off much less moisture
 “during the first four hours ventilation, when it
 “ought to have wasted the most, on account of
 “it’s being then wettest, this was owing to the
 “foggy haziness of the morning : which as it
 “went off, and broke out into fine warm sun-
 “shine, towards ten o’clock, so the air being
 “thereby become dry, it imbibed moisture more
 “strongly from the corn : and that this was the
 “true cause of the difference, is farther confirmed
 “by a like experiment which I had before made
 “on a gallon of wheat, April the first, there be-
 “ing then a very dry north-east wind.

“It will be adviseable to begin to ventilate corn
 “as soon as possible after washing, that the mois-
 “ture may have the less time to soak in : for the
 “less the moisture soaks in, so much the sooner
 “the corn will dry.

“If the moisture is so easily carried off from
 “wet wheat, by ventilation, this method will
 “doubtless much improve what is called cold
 “wheat, viz. such as is grown, and has been
 “housed in a cold wet season ; and will therefore
 “soon carry off the moist vapours which arise from
 “corn, and which cause it to heat and grow musty.”

*Other experiments on the preservation of Corn by
 Ventilation only.*

The prior of the royal abbey of St. Stephen in
 Caen filled a granary of preservation 12 feet wide,
 13 feet long, and six feet deep, which forms a
 parelle-

parallelepiped of 936 cubic feet, constructed according to M. Duhamel's instructions, with wheat that had been kept all the winter in a common granary. It was cooled from time to time by two bellows, which two men worked by means of a leaver; and though the place where this granary of preservation stood, was neither so dry nor so airy as might have been wished, the corn kept perfectly well in it^r.

In the beginning of September 1754, M. Vandsfel filled one of M. Duhamel's granaries of preservation, seven feet square and six feet deep, with good wheat, undried. It heated a little at the end of eight days; but two men, with a small double ventilator, cooled it in two hours time. It began to heat again about a week after, when he repeated the same operation, which cooled it presently. By the 20th of October it was quite cool, though it had not then been ventilated for fifteen days; and according to a letter of his writing to M. Duhamel, dated the 14th of October 1756, it still continued in the same good condition. Corn of the years 1754 and 1755, not dried, but only ventilated, had likewise kept with him as well as could be wished^s.

M. Duhamel filled one of his little granaries with oats, and another with barley; to try whether these grains may not be preserved as well as wheat, by ventilation only^t.

The oats remained cool, and kept extremely well: but the barley emitted so great a quantity of moisture, that the boards at the bottom of the granary were quite warped by it; and this grain heated to such a degree, that the bellows worked by hand could not cool it, though constantly plied for eighteen months together. When this granary

^r DUHAMEL, *Traité de la Culture des Terres*, Tom. V. p. 308. ^s *Ibid.* p. 310. ^t *Ibid.* p. 302.

was emptied, it's inside was found to be covered with a stinking glutinous moisture, which had communicated itself to the whole mass of this corn. M. Duhamel then judged that all of it was spoiled; especially as the heat had spread to every part of the granary, and the outside of the corn was rotted all over near two inches deep, and stuck to the sides and bottom of the granary. He likewise perceived that a prodigious number of weevils had bred in this barley. However, resolving to try whether he could not yet make something of this corn, he ordered it to be put into his stove, and then to be sifted and winnowed, to clear it of the grains that had no flour in them, which were pretty numerous. This operation lessened the mass by about one twelfth: but the good grain was rendered very dry, and had no bad smell.

EXPERIMENTS ON THE PRESERVATION OF CORN
BY STOVE-DRYING * ONLY.

WHEN the corn is too moist to be laid up in the granary of preservation, M. Duhamel proposes two methods of preparing it for that purpose †.

The first is, to keep it near a twelve month in a common granary, during which there will be sufficient opportunities to use all means of cleansing it; and by these operations it will lose so much of it's moisture, as to be perfectly fit for the ventilating granary.

* It is to be remembered, that a kiln, or an oven, will do equally well in this country, especially for small, or middling quantities of corn; though I use M. Duhamel's expression, *Stove-drying*, because I am giving his experiments.

† *Traité de la Conservation des Grains*, p. 74 and 76.

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Remark. This will answer for such as desire to preserve the produce of their own lands only, and are already provided with a good common granary: but those that would buy a large quantity of corn, when the price is very low, for the chance of selling it at a better market, must follow his

Second method, which is, to dry it in a stove (an oven or a kiln may do equally well) as soon as it has been thoroughly cleaned, and then to pass it through a wind-screen, to cool it, and cleanse it from dust. After this, it may be put into the granary of preservation without fear, as will appear by the following experiments.

Experiment on 90 cubic feet of fine wheat dried in a stove, and preserved without ventilation^a.

This wheat, though very full of smut and dust when it was reaped and threshed, was so well cleansed as to have no fault remaining but dampness. It was dried in a stove, by which it lost a little disagreeable smell it had before; and when it was thought to be sufficiently dry, it was laid up in one of M. Duhamel's granaries of preservation, which had bellows adapted to it: but there was no occasion to use them; for the corn kept extremely well without ever being ventilated.

Remark. This experiment shews, that wheat well cleaned and dried need not be ventilated.

Experiment on 75 cubic feet of small wheat mixed with smut, preserved by stove-drying only, without ventilation.

^Y" Our different screens, says M. Duhamel^{*} separated the fine large wheat from the small, and

^a *Ibid.* p. 77.

^{*} *Ibid.* p. 79.

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cleaned the former perfectly: but all our care could not free this small grain from smut, dust, &c. of which much remained among it; nor did the stove clear it from the bad smell it had contracted.

“Frequent ventilation would undoubtedly have taken away that bad smell, or at least have prevented it’s increasing: but as the design of this experiment was to try the effect of the stove only; we determined not to ventilate, unless there should be great danger of the wheat’s corrupting; which did not happen. However, the bad smell increased so much, that we were obliged to stove-dry it again after it was taken out of the granary of preservation, and to screen it several times. With these precautions, it made pretty good bread.

“*Remark.* This experiment shews, first, how necessary it is to clean the corn well before it is put into the granary of preservation; and that both ventilation and stove-drying are requisite in some cases: and secondly, that corn which has contracted a bad smell, may be cleared of it by the stove and the wind-screen.

Wheat which had begun to grow, and had contracted a bad smell and taste, preserved by stove-drying only.

A parcel of wheat of the growth of 1755, which was a very wet year, had begun to grow, and had contracted a very bad smell and taste. It dried perfectly in the stove, came out in excellent condition for keeping, and had lost it’s offensive smell: but if it was chewed, it still had a disagreeable taste. The dough made of the flour of this grown corn, which seemed to have been so well recover-

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ed, did not rise in the kneeding-trough, and the bread made of it was very heavy, and of a disagreeable flavour.

After thus shewing that good wheat, well cleansed, and properly dried in a stove, may be preserved without ventilation; and that such corn, tolerably dry, may be preserved by ventilation only; M. Duhamel rightly concludes, that it must be most advantageous to join both methods, especially for large magazines; and as a proof thereof, he gives us the following

EXPERIMENTS ON THE PRESERVATION OF CORN BY STOVE-DRYING AND VENTILATION.

EIGHT hundred and twenty five cubic feet of large grained wheat, of the growth of the year 1750, which was of but a middling quantity, were put into one of his granaries of preservation, after having been well cleansed, and slightly dried in a stove. The bellows of this granary were worked by swifts like a wind-mill.

This corn had a bad smell, which was not entirely dissipated by the stove, but was quite carried off by careful ventilation. It not only kept extremely well, but was even meliorated, and became of so good a quality, that the bakers preferred it to all other, and gave ten pence a sack more for it, than for the same wheat preserved in the common way ².

M. Duhamel had a parcel of wheat of the year 1755, which, having been reaped in rainy weather, continued extremely damp: and though care had been taken to turn it every week, from the time of it's being removed out of the barn, it had contracted a very bad smell, not unlike that of pigeon's

² *Traité de la Conservation, des Grains, p. 81.*

dung.

dung. This determined him to stove-dry it for forty eight hours. He did so in May 1756, and it was thereby cleared of that putrid scent. He then ordered it to be sifted immediately, to cool it, and cleanse it from the small dust which falls off dry-corn, and then to be laid up, and frequently ventilated, in one of his granaries of preservation. His directions were followed, and this wheat remained perfectly cool, sweet, and sound^a.

Remark. We see by these two experiments, that either ventilation, or stove-drying, will remove the putrid smell of corn; and we have in this last a remarkable instance of the good effects of the stove, since it rendered capable of being preserved, wheat which could not have been kept in the common way.

It is, however, to be observed, that both dried and undried corn will contract a disagreeable smell, if suffered to remain a month without being ventilated. This smell is perceived most when the bellows first begin to work; but it then is dissipated in a few minutes. It is not a symptom of corruption or decay, but only a strong smell of corn; such as is always perceived on entering into a granary that has been shut for any length of time.

Great as our obligations to M. Duhamel are in very many respects, they do not end here, even in this. Indefatigably studious to be of real service to mankind, and too intelligent not to see at once the extent of his judicious experiments; it cannot be supposed that one of the greatest obstacles to the keeping of corn, which is the insects that breed in it, could escape his attention. Of these, the most universally formidable are the false moth and

^a *Traité de la Culture des Terres, Tom. V. p. 299.*

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the weevil*: and he accordingly speaks of them in all his writings upon agriculture, where he at the same time relates various trials made to destroy them, and points out the means hitherto found best to answer that desirable end.

Of the false Moth, or Corn-Worm; with the means of destroying it.

TO the description before given† of this pernicious insect, and of its manner of preying upon corn, little need be added here, except the experiments by which it has been destroyed.

In it's state of moth, it is grey, has six legs, and is frequently seen in vast numbers fluttering about the eaves and windows of granaries, in the spring and summer, when the weather is very hot. The females lay their eggs upon the heaps of wheat, and these eggs produce the caterpillars, or corn worms as some call them, which feed on the grain, and envelop it with their silky web, so as to form over the whole surface a crust that is sometimes three or four inches thick. This entirely spoils the corn within than depth, besides communicating a bad smell to all the rest. These worms, or rather caterpillars, for they have sixteen legs, are smooth, whitish, and seldom exceed a quarter, or at most the third part of an inch when at their full growth. Breaking of their webs avails but little, for they are woven again by the next day: for which reason some have been of opinion, that it is best to let them enjoy undisturbed the surface

* I do not here mention the corn caterpillar, because it is a local scourge, peculiar to the province of Angoumois, and has been already treated of very fully. See p. 45 — 91 of this Volume.

† See page 53.

of the corn of which they have taken possession. But it should be considered, that three inches are a sixth part, and four inches upwards of a fifth, of any quantity of corn spread eighteen inches deep, which is the medium thickness at which it is laid; and that, independant of the bad smell with which the rest is tainted, this is a very considerable object, though it extend no farther. When this crust is broken, most of the grains which compose it are found to be either gnawn in their inside, or full of live worms, or of aureliæ, according to the season; or one sees only the empty sheaths of the caterpillars, if the aureliæ have been transformed into moths.

It is said, that strewing the corn with powdered lime, so as to form a crust over it, will preserve it from the ravages of these insects: but as the surface would still be spoiled, and as that surface may be a considerable part of the small provision of wheat allotted for a family only, M. Duhamel did not try this expedient. Covering it with hay, which he did try, answered no end whatever.

These observations, and the reflections consequent thereon, made him suspect that this insect, as it delights in none but very warm places, would not be able to live in the cold air of his ventilating granaries.

Accordingly, in the winter of the year 1746, he collected all the wormy crusts which these caterpillars had formed in his common granaries, where they were very thick, the moths having been extremely numerous the preceding summer. These crusts were broken and screened; and what

^d DUHAMEL, *Traité de la Conservation des Grains*, p. 87. and *Eléments d'Agriculture*, Tom. I. p. 419.

^e *Eléments d'Agriculture*, Tom. I. Liv. 5. c. 2. ^f *Ibid.* p. 19.

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grain could be got from them, which undoubtedly was impregnated with the eggs of the moths, was put into one of his granaries of preservation, which contained seventy five cubic feet, and was ventilated from time to time during all the winter. Towards the end of May, when the vent-holes at the top of this granary were opened, a prodigious number of moths flew out; which shewed that they did not like their situation.

When the wheat was thought to have been ventilated sufficiently, the holes were shut close, and nothing more was done to it for a month: for as this corn (which had not been stove dried) was old and dry enough, it was but seldom ventilated. In June 1747, this granary was emptied; all the moths and worms were dead, and there remained only a thin crust, not above a twelfth part of an inch thick, on the top of the corn, which had so far lost the bad smell it had when put into the granary that it sold for the current market price^s.

Not satisfied with this single method, M. Duhamel tried the effect of the stove upon another parcel of wheat known to be full of these worms. A heat of from 45 to 50 degrees of Réaumur's thermometer (from 115 to 124 of Farenheit's) killed them all. This corn was then laid up in a common granary, where it remained two years without being attacked by any of these moths; and even in the third, but very few of them appeared^h.

These experiments remove all doubt of the possibility of destroying the corn-moth, or worm, without hurting the grain, which would otherwise be spoiled by it: and as that grain generally is

^s *Traité de la Conversation des Grains*, p. 88.

^h *Eléments d'Agriculture*, Tom. I. Liv. 5. c. 2.

wheat (for this insect always prefers it to any other), this discovery is of very great importance to the husbandman, and to the public.

The weevil, of which I am next to speak, is much more difficult to conquer.

Of the Weevil, and the means of destroying it.

THIS insect is of the beetle kind, resembling a small May-bug, with a long sharp pointed head, to the hinder part of which are fixed two antennæⁱ. It is black, and therefore easily distinguished in any corn: but it's principal and favourite food is wheat, of which, either old or new, it devours great quantities; without, however, communicating any bad smell to it, as the moth does. Some call it the *corn-louse*, because it bites animals more strongly than fleas do. This has made it to be looked upon as a carnivorous insect; and many have pretended that it devours both the worm and the chrysalis of the false moth: an opinion which M. Duhamel does not think improbable, because, in effect, very few of those moths are ever found in corn where there are many weevils.

Upon thrusting one's hand into a heap of corn, one may easily perceive, by it's heat, whether it contains many of these insects, which generally lie pretty much collected; and the particular places where they are most numerous, feel much warmer than the rest. This observation soon led M. Duhamel to think, that a considerable heat is probably necessary for the hatching of their eggs; and that, in this case, even if they should live, they will not be able to breed, in his ventilating granaries.

ⁱ *Ibid.* p. 414.

To ascertain this fact, he put some weevils into wheat (not stove-dried) in one of these granaries, in May 1751. It was well ventilated from time to time, and opened in August 1752, when none of them were found. He did the same with wheat which had been stove-dried; and when the granary was emptied, a year and half or two years after, not a weevil could be seen ^b.

He again put some weevils into a ventilating granary in which wheat of the year 1754 was laid up, without having been stove-dried. This corn was taken out in May 1756, and sifted over a fine screen, which gave him an opportunity to observe whether the weevils had increased. Their number seemed to him nearly the same as that he had put in; and a farther reason which induced him to think they had not multiplied, was, that this grain, instead of being heated, as corn is well known to be whenever weevils breed in it, was so cool, that a country fellow employed for this work could hardly remain bare-footed among it ⁱ.

In 1755, Dom Edward Provenchere, procurator of the Carthusians of Liget, near Loches, in the province of Touraine, intending to make some experiments on the preservation of corn, chose for that purpose a large cask, at one end of which, a little above the common bottom, he put a floor of lattice work, and over that a canvas. This cask was filled with wheat of the harvest of 1754, of which it contained 1080 pounds. He then fixed to it a pair of middle sized bellows, so situated that they might easily be worked; and nearly in the centre of this corn, he put as many weevils

^a *Traité de la Culture des Terres*, Tom. V. p. 298, and *Traité de la Conservation des Grains*, p. 97.

^b *Culture des Terres*, Tom. V. p. 299.

ⁱ *Ibid.*; Tom. V. p. 298.

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as weighed six drachms; which is pretty considerable for that quantity of grain.

The bellows were blown an hour every week. In the beginning of September 1756, when that operation had been neglected for some time, the corn began to heat: but it was soon cooled again by using the bellows. The 15th of October, on taking the corn out of this cask, in which it had kept perfectly well, not above twenty weevils were found in it. Dom Edward says he saw that insect come out of the vent-holes every time the bellows were blown. He perceived in many places several grains of corn linked together by threads, certainly formed by moths that were in his wheat (which had not been stove-dried), and, not dying immediately, had had time to spin their web*.

Dom Edward filled another cask with 900 pounds of barley, not stove-dried, and put into it six drachms of weevils. Though care was taken to ventilate this cask as much as the former which was filled with wheat, that is to say, during an hour every week, yet this corn heated prodigiously: the bellows could not cool it, and the weevils multiplied in it exceedingly.

“ This, says M. Duhamel^k, is the very thing
 “ that happened to me in my larger experiment
 “ on the same kind of grain †. Barley probably
 “ contains a great deal of moisture; and the
 “ question is whether stove-drying can be able to
 “ preserve it. The increase of the weevils here
 “ seems to prove, that this insect cannot multiply

* M. Duhamel wishes here for as strong proofs that the weevil cannot live in his ventilating granaries, as has he had that the moth cannot. *Traité de la Culture des Terres, Tom. V. p. 306.*

^k *Ubi supra. p. 307*

† See p. 130.

“ in

“ in corn which retains a proper degree of coolness.”

Though the above experiments seem to prove pretty clearly, at least that the weevil cannot breed in corn which is kept properly cool, and that if any sure way to destroy this insect be ever discovered, it will be most likely to succeed by means of the ventilating granary; yet M. Duhamel, with his constant candour and unvaried zeal for the welfare of mankind, exhorts the naturalist, the philosopher, the lover of the public good, not to rely too much on any thing that he has said in this respect; to look upon the trials which he has related, as steps only which may help to lead to that desired end; and to continue their endeavours to render to the world the important service of shewing how this creature may be effectually exterminated, by any safe and practicable method.

“ I have tried, continues he, in his latest writings upon agriculture¹, many of the receipts most vaunted in books of husbandry, as remedies against the weevil, and have not found the least benefit from any one of them. All that they have taught me, is that this animal will endure a great deal before it can be killed. It will live a long time without eating: cold will benumb it so as to make it appear to be dead; but I have put some of them, in that state, into a warm place, and after keeping them there for some time, have found that they were perfectly alive: the great coolness of my granaries has seemed to prevent their increase; but it has not killed them. They bear easily a heat of from 45 to 50 degrees of Réaumur's thermometer (from 115 to 124 of Fahrenheit's). I kept corn in which there were many weevils, during half an hour, in a place heated to upwards

¹ *Eléments d' Agriculture, Liv. c. 2. Art. 3.*

of 80 degrees of Réaumur's thermometer (210 of Fahrenheit's): some of them perished; but others remained alive. They, therefore, who would destroy them by such a degree of heat, must let their corn be exposed to it during seven or eight hours at least*.

"I grant that the smoke of sulphur will kill any insect; but that method is not practicable in granaries: for this vapour, which is very light, ascends to the top of the granary, and scarcely acts at all upon the corn on the floor. It is true, that the corn may be so disposed as to let this smoke pass through it, and all the insects in it will then be destroyed. But, at the same time, this smoke will give the corn a very disagreeable and lasting smell, which depreciates it entirely. Consequently this method will not do.

"It is confidently said, that the weevils may be driven away by turning the corn with shovels rubbed with essence of turpentine. To try whether this essence really displeases them, I ordered two large cases to be made: the inside of one of them was rubbed with essence of turpentine; both of them were filled with corn in which there were many weevils; and the insects remained as quiet in the one as in the other. It is true, that when corn infested with weevils is turned with a shovel, several of those insects quit the heap, and hasten towards the walls of the granary. This may have been imputed to the rubbing of the shovel with

* A still longer continuance of heat will therefore account for their being killed, in M. de Cers's experiments (p. 86. and 87), in one case by $42\frac{1}{2}$ degrees of heat according to M. de Réaumur's thermometer (110 of Fahrenheit's): and in the other, by a heat which raised the former to only 40 degrees, which are equivalent to but 105 of the latter. These experiments were, indeed, made in an oven: and how far that may have contributed to stifle the weevils, more than a stove might do, I cannot pretend to say.

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oil of spikenard or essence of turpentine: but the same thing happens when the shovel has not been rubbed with any drug whatever; and the fugitive weevils soon return to the heap of corn.

“When corn is sifted in a sieve (and the same is applicable to a screen) fine enough to retain the grain; the weevils, then agitated, shrink up their legs, and are, in that posture, generally so much smaller than the good corn, that very many of them drop through the sieve. The greatest part of them may therefore be destroyed by this method, which is a very good one: but, unfortunately, there will still remain enough of them among the corn, to do considerable damage. This sieve or screen, should be of wire; and under it should be placed an earthen or copper vessel, pretty deep, to receive the insects, and smooth on it's inside, to prevent their getting out easily.

“Of all the methods I have tried, that which has seemed to me to be the best, is to dry the corn in a stove, or oven, heated to 80 or 90 degrees of M. de Réaumur's thermometer (from 210 to 230 of Fahrenheit's) and to let it remain there twelve hours. I exhort all those who wish the welfare of the public, to study the means of destroying the weevil, and, in consequence thereof, to make particular experiments: but I beseech them not to publish their discoveries till they have made repeated trials of them, and that in different granaries: for I have sometimes seen these insects forsake a granary, when no cause could possibly be assigned for their so doing.”

M. Duhamel, extending his views to every object of public utility, speaks thus

Of the Preservation of Corn in Ships^m.

“The greatest care cannot always guard against the wants of a nation whose harvests are

^m *Conversation des Grains, c. ix.*

uncertain, or whose crops have failed; so far as to prevent it's being sometimes obliged to have recourse to other countries. Corn is then conveyed thither in ships, of which there are few that do not let in some water, the moist vapours of which, especially when it is corrupted and stinks, as it often does very violently, diffuse themselves throughout the hold of the vessel, where alone the grain can be stowed. These putrid exhalations, joined to those of the salted provisions, cheese, &c. stored in the same place, communicate a bad smell to the corn; while the close, heated, and damp air in the hold, disposes it strongly to ferment. In this situation, wheat in particular, which is the most susceptible of these impressions, has frequently been irretrievably damaged. The moisture has swelled it, the heat has made it grow, and the bad smell has utterly spoiled it's quality.

“ The Dutch, to preserve the corn which they send by sea, dry some of it very much, and even parch a part of it in ovens; after which they mix this with the rest, to absorb the moisture of the whole mass. But this method, though it diminishes the evil a little, does not preserve the corn totally from the injuries before mentioned; and the parching of the grains hurts the quality of the bread. I therefore prefer the following method.

“ Let cases, or granaries of preservation, like those before described (*Plate II. Fig. 4. and 5, and page 116*), be closely caulked along all their seams, and well paid over their whole outside, to prevent the entrance of any moisture, and let the corn designed for shipping be deposited in them, after it has been thoroughly dried in a stove. The vent-holes here must be doubly secured with close netted wire, to guard against rats, which are extremely

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extremely formidable in ships *. One large pair of bellows placed between deck, will be sufficient to ventilate all the cases in the hold, or any one of them singly, by means of a leathern pipe or pipes, which will convey the wind down to it, or them. In general, if they are ventilated one after another during the voyage, the bellows should be worked every day, an hour and a half in the morning, and the same in the evening. When the corn is landed, it should be stove-dried again, to carry off what moisture and bad smell it may have contracted in the hold of the ship. By this means the grain will certainly be well preserved, in good condition, and fit for laying up in common granaries, or in granaries of preservation, if it be intended for long keeping. The expence attending this method will not, upon an average, be found to exceed, if it equals, the damages and hazards to which corn is exposed when it is shipped in the usual way. This may likewise be applied to the carriage of corn upon rivers, where the current of the stream may, perhaps, be made to work the bellows."

* Though I cannot warrant the efficacy of either of the following receipts for killing rats, from any experience or certain knowledge of my own: yet they are so strongly recommended, as infallible for that purpose, that I ought not to omit mentioning them here.

The first has the sanction of the Dublin society, who, on the 19th of November 1762, ordered a premium of five guineas to one Laurence O'Hara, for this discovery; which is "One quart of oat-meal, four drops of Rhodium, one grain of Musk, and two nuts of *Nux vomica* finely rasped." This mixture is to be made up in pellets, and laid in the holes and places which the rats frequent.

The other receipt is thus: "Take of the seeds of staves-acre, or louse-wort, powdered, one fourth part, and of oat-meal three parts; mix them well and make them up into a paste with honey. Lay pieces of it in the holes, and on the places frequented by rats or mice, and it will kill such of those vermin as eat thereof." *Gent. Mag. March 1763.*

PRAC-

PRACTICAL HUSBANDRY,

PART III.

OF PASTURES.

HAVING now given the best account that my utmost care and attention could enable me to collect, of the culture and management of all the various kinds of grain and pulse, in their several states; I proceed to treat of pastures, a subject of great importance to the farmer, and to the public. This is by much the least expensive, but by no means the least profitable, part of Agriculture; and therefore claims the husbandman's special attention.

The judicious Cato, being asked, as Pliny tells us^a, which is the surest way of getting money, answered, "Providing plenty of food for cattle:" and being farther asked, which is the next best way, he replied, "Providing less plenty of food for cattle." In effect, cattle, which may be said to be the ultimate produce of pastures, are always a ready marketable commodity, and of easy transport. To this nation, in particular, pastures are the basis of un-rivalled prosperity, the source from whence our golden fleece arises, and the means of victualling those floating castles which carry the British glory, and commerce, from pole to pole.

In prosecuting my task hitherto, the subject has swelled much beyond my first intention; because I have chosen, upon mature deliberation, and in

^a Cato interrogatus, quis esset certissimus questus, respondit, si bene pascas. Quis proximus? Si mediocriter pascas. *Hist. Natural. Lib. XVIII. c. 5.*

consequence of the advice of very competent judges, rather to leave nothing unsaid, which may be of service to mankind in their rural concerns, than wilfully to maim my performance, by confining it, right or wrong, to precisely fixed dimensions. Such shackles, devised by certain venders of books, who would subject the whole circle of sciences to the mechanical standard of sizes suited to their shops, are inconsistent with a writer's duty to the public, and with what he owes to himself, if he values his reputation. I do not, however, here mean to bespeak for myself an unbounded latitude in favour of this System of Agriculture. On the contrary, I promise, that, though I shall endeavour not to omit any material instruction, it shall not exceed the limits really necessary for the many important objects which interest the husbandman, and consequently the whole world, and of which I have engaged to treat. In short, my study shall be, to render it as generally useful, and as little expensive, as I possibly can.

As the first volume of this work contains ample instructions for the farmer thoroughly to prepare his land; I shall now suppose it to be in perfect tilth, and consequently fit for the production of all such plants as are used for the food of cattle. Here I shall begin with those that are intermixed, or interchanged, with crops of corn: I shall then proceed to such as are of longer duration, but require frequent help; and I shall end with pastures laid down with common grass.

In treating of this subject, I shall extend the meaning of the word *Pasture* much beyond the usual acceptation, by including under it, as Pliny has done ^b, every substance given as food to cattle.

^b *Ubi supra. c. 20.*

C H A P. I.

Of such Plants as are usually intermixed with Crops of Corn, or which may be cultivated interchangeably with Corn or Pulse.

I Shall divide these into three classes; viz.

1, Those of which the roots are the principal part used for pasture; such as turneps, carrots, parsneps, parsley, potatoes, &c.

2, Those whose leaves and seeds are used for pasture; such as cabbage, cole, rape, &c. and

3, Those which are properly called grass; as clover, rye-grass, perennial vetches, &c.

S E C T. I.

Of Plants whose Roots are the principal part used for the food of cattle.

A R T. I.

O F T U R N E P S.

IT is Pliny's opinion ^c, that if due order were observed, turneps ought to be esteemed next to corn, or at least next to beans; for that, after them nothing is of greater use. They grow, says, he, for all animals: four-footed beasts delight in their leaves; men are as well pleased with their tender shoots, in their proper season, as with sprouts; and their roots are so great a relief when there is a scarcity of corn, that they are capable of preventing a famine ^{*}. Mr.

^c *Ibid.* c. 13.

^{*} The Philosophical Transactions relate (No. 90), that in the years 1629 and 1630, when there was a dearth in England,

Mr. Miller is therefore justly surpris'd^a that so great an improvement as the sowing of turneps in fields, for feeding cattle, should have been so long neglected as it was in every part of Europe; since it is very plain that this husbandry was known to the antients: for Columella, likewise, in treating of the several kinds of vegetables, which are proper for the field, recommends^b particularly the cultivating of good store of turneps, because such of them as are not wanting for the table, will be eaten by cattle* Yet it is not many years since the raising of this plant for the food of cattle has been in general use; nor is the right method of cultivating turneps yet sufficiently known, or at least it is not practis'd, in

^a *Gardener's Dict.* Art. RAPA.

^b *Lib.* II. c. 10.

very good, white, lasting, and wholesome bread was made of boiled turneps mixed with a small quantity of meal. They fermented well, and kneaded kindly together. And again (No. 205), that the dearth of all sorts of corn in the year 1693, occasioned many poor people in Essex to make bread of turneps. Their way of making it was to peel the turneps, and boil them in water till they were soft and tender: then, after strongly pressing out the juice, they mixed them with an equal weight of wheat meal, added a proper quantity of salt and yeast, and, with warm water, kneaded this up like other dough or paste. They then let it lie a little while to ferment, and afterwards baked it as common bread. This turnep bread, continues my above authority, is not to be distinguished by the eye, from common wheaten or household-bread; neither does the scent much betray it, especially when cold; only to dainty and nice palates, the turneps are a little, and but a little, perceived.

* Mr. Miller might, and I think he should have added to this quotation, Columella's saying very expressly, that turneps are the first of vegetables next to corn; and that they were greatly esteemed and cultivated for the food of cattle, even in his time, particularly in Gaul, where beasts were fed chiefly with this root in the winter. Columella's directions for cultivating turneps are nearly the same as the very best methods that are followed now; which shews to what height the ancient Romans had carried their knowledge in Agriculture. See
L. I. M. COLLUMELLÆ II.

some

some of the distant counties of England; for in many places the seed is sown with barley in the spring, and those turneps which come up, and live till that corn is cut, produce a little green for sheep to pick up, but never have any roots: and in others where the turnep-seed is sown by itself, the method of hoeing the plants is not understood; so that weeds and turneps are permitted to grow together, and where the turneps come up thick in patches, they are never thinned; through which neglect they draw up to have long leaves, but never have good roots, which is the principal part of the plant, and therefore should be chiefly attended to.

The sorts of turneps most profitably cultivated for the food of cattle, which is our only object here, are the red or purple topped, and the large green topped turneps. The roots of both of these, which are only varieties of the same sort †, will grow to a large size; but those of the latter continue longest good: for which reason this is generally, and rightly, preferred. The red or purple topped turnep is also extremely good for some time; but it's roots become stringy much sooner than those of the green topped; for which reason it is not now so much cultivated as it was formerly. The long rooted turnep, the yellow turnep, and the blackish rooted turnep, are now rarely cultivated in England; neither of them being so good, either for the table, or to feed cattle, as the red and the green topped turnep. The Dutch turneps, and the French, are well tasted while they are young; but they become rank and stringy when suffered to grow to their full size, which is not large: consequently these are not fit for cattle.

† Namely, of the *Rapa radice orbiculatâ depressâ carnosâ*; which is C. Bauhin's *Rapa sativa*, *rotunda*, *radice candidâ*.

The green topped turneps, which are the softest and sweetest tasted, grow more above ground than any other sort of this plant; and therefore are, besides being the best in all other respects, the most convenient for the feeding of cattle. Their long tap root supplies them with sufficient nourishment. But this situation renders them very liable to be hurt by frost, in severe winters, especially if they are not covered with snow: for alternate hard frosts and thaws will make these rot sooner, than those whose flesh is less tender. M. Duhamel has had turneps of this sort upwards of nine inches in diameter, and which weighed above twenty pounds; and Mr. Miller has seen some of them boiled, of more than a foot in diameter, which were as sweet and tender as any of the smallest roots^d.

Turneps thrive best in a light, sandy, loamy, and deep soil †. If it be moist, they will grow the

^e *Eléments d'Agriculture*, Tom. II, Liv. 9, c. 4.

^d *Gardener's Dict.* Art, RAPA.

† The Society of Improvers in the knowledge of Agriculture in Scotland observe^a, that, "though it be generally thought that the natural soil for turneps is a light sandy ground; yet there seems to be no reason to found exceptions against other soils, provided they be cultivated as they ought; for, by an experiment mentioned in the Transactions of the Royal Society (No. 360), it has been found, that on moss or peat-ground, turneps have by growth increased 15,990 times the weight of their seeds each day they stood upon it,—It is true that small seeds especially thrive best in a fine mould; and as light soils are most easily made fine, they are thought to be the best for them. But why," add those gentlemen, "may not clay be made fine enough by the plough, harrow, and roller?—The plowing for turneps and all tap rooted plants should be as deep as possible, that their roots may the more easily descend. Indeed if deep plowing is neglected, turneps may well thrive better on

^a *Maxwell's Collection of Miscellaneous papers on Husbandry*, p. 20 and 21.

"sandy

the better in summer, especially in fresh land, where they are always sweeter than upon an old worn-out soil. For them to grow very large, the ground must have been well prepared and well manured some time before sowing: for dung laid on then would breed insects, which would damage the roots, and kill the plants. In Norfolk, a county famous for the culture of turneps, they dung their ground for this plant as much as they possibly can; even to such a degree, that their dry-land meadows are quite impoverished thereby. Even Mr. Tull allows the necessity of dung in this case, because, as turneps have commonly less time to grow than other plants, dung and tillage together will effect the necessary degree of pulverisation, sooner than plowing can do alone.

The land, for turneps, ought to be in the very finest tilth, of which having treated sufficiently in the former part of this work, I shall only add here, that if the ground is not in so good order as the farmer could wish, it must be laid up in ridges in the winter, to be mellowed by the frost, and, by repeated plowings and harrowings during

* LITTLE'S *Observations in Husbandry*, Vol. II. p. 26.

"sandy grounds, than on clay; because the former, though unfirred, is more penetrable by their roots, than solid clay."

The Society is undoubtedly right as to means of pulverising clay, and of thereby rendering it light: but Mr. Little tells us^b, from his own experience, that turneps raised in clay-land are apt to be so rank as not to be eatable; and that those which grow in a white lightish down-land are always very sweet; though this last is generally accounted the worst of all soils for this root. Turneps ought, in clay ground, to be but just harrowed in with a bush, as light as may be; for they will not else be able there to grow their full dimensions, and their being checked in their growth will make them knotty and sticky.

^b *Observations in Husbandry*, Vol. II. p. 35.

the spring and in the beginning of the summer, it must be brought to that proper state.

M. Duhamel has had surprizingly large turneps in ground loosened to the depth of three feet; but he does not advise going quite so deep, because that would be too expensive. However, it proves the advantage of deep plowing.

This plant has also succeeded perfectly well when sown on ground made mellow by a crop of rank peas, and only harrowed in without plowing^b.

The common season for sowing of turneps is any time from the beginning of June to the middle of August, or even a little later; and, if possible, just before a shower of rain*: but it is not advisable to sow them much later than August, because, if the autumn should not prove very mild, they will not have time to apple before winter; nor will the roots of those which are sown after the middle of July grow very large, unless the frost keeps of long in autumn. The seed must be harrowed in as soon as it is sown, with a short tined harrow, and the ground rolled with a wooden roller, to break the clods and make the surface even: but it should not be buried above an inch deep, especially if it be that of the large sort which grows almost out of the ground. Two pounds of seed are full sufficient for an acre of land sown broad-cast: but one pound is the common allowance in that way. Three or four ounces

^a *Eléments d'Agriculture, Tom. II. Liv. 9. c. 4. Art. 3.*

^b *LISLE's Observations in Husbandry, Vol. II. p. 32.*

* This seed, says the Edinburgh Society, should be sown in a moderate rain, or immediately after it: but if the season should continue long dry, and the time of sowing be like to go over, it is advised, rather than to wait too long, to steep the seed in soft water ten or twelve hours, then to dry it with powdered chalk; and to sow it immediately. *MAXWELL's Collection, p. 19.*

are the usual quantity to drill, as will be observed in the account of that method, which will follow this.

Turneps should always be sown upon an open spot of ground : for if they are near hedges, walls, buildings, or trees, they will draw up and be very long topt, but their roots will not grow to any size. They are sown in great plenty in the fields near London, not only for the use of the kitchen, but for feeding cattle in the winter, when there is a scarcity of other food ; and this way is become a great improvement to barren sandy lands, particularly in Norfolk, where many persons have doubled the yearly value of their ground by the culture of this plant.

No seed is so uncertain as that of turneps ; for frequently the plants rise only in patches, in which case the surface of the vacant spaces must be loosened with a hand-hoe, and fresh seed must be sown, and covered over with a rake : at other times, husbandmen have been obliged to sow the whole ground, quite anew, two or three times before it would take. The chief expence here is, indeed, the labour ; for this seed is very cheap : but the ground should always be loosened, especially if it be stiff land, either by hoeing or by harrowing, before it is sowed. If all these precautions fail, as they sometimes do ; or if the fly, which is a cruel enemy to this plant, has eaten off the young crop, so as to render it not worth the farmer's while to let the remainder stand ; M. Duhamel advises plowing up the field and sowing it with vetches, for green fodder ; or leaving it till autumn, then to give it a plowing, and to sow it with wheat.

i *Eléments d'Agriculture, ubi supra,*

Mr.

Mr. Lisle is inclined to think ^k, that the best way to manage turneps (the feed of which, says he, is impatient of growth, and apt to burst in too much wet, as also to corrupt, if the ground be so dry as only to give it a damp, but not wet enough to set it on growing) is, first to harrow the ground fine, after it has been brought to a perfect tilth by plowing, then to roll it with a roller big enough to break the little clods, if any such remain, and so to let it lie till the next rain; then, the ground being mellow, to sow the seed, and harrow it in with short-tined harrows, which may not open the ground too deep, nor bury the seed; then roll it again with a one-horse roller, in order to keep the moisture in the ground as deep as the seed may lie: for the surface of the earth must not be dried before the seed can strike root, which may be in twice twenty-four hours: and yet that surface must be so fine, and so lightly compressed, that the seed may spear through it. He takes the mystery, as he calls it, of the success or miscarriage of a crop of turneps to consist in these four things, viz. first in the seed's not lying too deep; secondly, in it's not lying too wet, which it cannot easily do if harrowed in shallow, for the surface of the earth is soon dry; thirdly, in it's not lying too dry; and fourthly, in it's lying in a fine bed. In another place^l, he tells us, that his gardener affirmed to him, that he had found turnep seeds, which had been dropped by accident and covered over with earth in digging, fresh and good a year after, when the earth was turned back again, and that it has then grown and produced good turneps: the reason of which he takes to be, that when this seed lies on, or very near the surface of the ground, nine or ten days of hot weather will

^k *Observation in Husbandry, Vol. II. p. 33.* ^l *p. 32.*

parch it so as to render it incapable of growing ever after: but in this case it was turned a spade deep under ground.

If the seed grows, the plants will appear in a few days if the season is moist; but it will be longer before they come up in dry weather, and then it is that they will be in most danger of being destroyed by the fly. When the plants have got four or five leaves, they should be hoed to destroy the weeds, and to thin those which grow too close together, leaving the remaining ones about six or eight inches asunder, which will be room enough for the plants to stand for the first hoeing; and the sooner this is done after they have four or five leaves, the better they will thrive: but in the second hoeing, which must be performed about a month or three weeks after the first, especially if the ground be much subject to weeds, the turneps, which will then be about as big as common apples, should be cut up, so that the plants may stand fourteen or sixteen inches from each other, or even more, especially if they are designed for feeding of cattle; for where the roots are allowed a good space to grow in, they will be proportionably large: so that what is lost in number, will be over-gained by their bulk. But in places where they are sown for the use of the kitchen, they need not be left at a greater distance than ten inches or a foot, because large roots are not generally esteemed for the table. After these two hoeings, instead of the first of which M. Duhamel advises a slight plowing all over the field, with a plough that has no fins to the share, as a speedier and cheaper way to thin the plants, the turneps will not require any farther care. They will have attained their full size in October, before the frosts come, and should then be taken up, stripped of their leaves, which may
be

be given to cattle, and laid upon hurdles in a dry place, with a layer of dry sand between each layer of turneps, which may be thus piled up, and which will keep very well in this condition, for the food of cattle during the winter^m. In Norfolk, they stow them in their barns, when intended for fattening of bullocks.

A dry season is the best for hoeing turneps, because neither the weeds nor the turneps hoed up then will be so apt to grow again: and M. Lisle supposes that care should be taken to hoe up those that are deepest rooted in the earth, and to leave those that grow upon, and almost out of it, without much regarding their size; because those which lie on the ground, and have room to grow, will soon become the largest.

Some sow turneps on their flax and hemp grounds, at the same time as they pluck up those plants, and the seed is pretty well buried by the stirring thereby given to the earth. Others give their corn stubble only a slight plowing after harvest, then sow the turneps very thin, and harrow in the seed. These methods do very well when the ground is in good tilth. Others again, sow late turneps, merely for the sake of their leaves, which they use as green feed, when they are about a foot high; and in this case they sow the seed very thick.

An easy way to have two growths of turneps in the same field, is to sow seed of the last gathering, and seed that is two years old; for this last is longer before it rises, than the new: and an advantage attending this method, is, that the turneps, by rising at different times, will have the better chance to escape the fly, or grub, which

^m *Eléments d'Agriculture, Tom. II. p. 176.*

sometimes

sometimes destroy them entirely: for it has been observed, that these flies often come suddenly in great swarms, and eat up the turneps as fast as they rise; and that they sometimes disappear as suddenly; so that the turneps which rise a few days after, in a neighbouring field, are not at all injured by them: consequently, when the turneps of the same field rise at different times, one or other may escape the ravage of these insects; for they destroy them only while in their seed leaf. The danger is over when they have put out their rough leaves pretty strong, as they will in a few days, if rain falls when they first come up. Dry weather at that time is consequently much to be feared.

One of the most effectual ways to guard against these insects, is to run a heavy roller over the whole field if sown in broad-cast, or a-cross the rows if the turneps have been drilled, as will speedily be directed. This rolling hardens the surface of the earth so that they can neither get in or out; by which means they are destroyed. But this pressure of the earth will be very hurtful to the plants, if the ground has not been deeply plowed, if it be moist, or if it be stiff and apt to bind. These inconveniencies are, indeed, partly remedied in the new culture, by hoeing the alleys as soon as the turneps have put forth their large leaves; for then, as I have just observed, they have nothing to fear from the insects, which the hoeing likewise helps to destroy. The horse-hoe is the only instrument with which this work can be well done; the earth being often so hard that the hand-hoe would only scratch it.

Of the many boasted receipts for preserving turneps from the fly†, few deserve any notice. I

† The fly which preys upon turneps is not unlike the weevil in corn: it is nearly of the same shape, and also has hard wings. there-

therefore shall only mention two or three, which Mr. Miller recommends, as having seen them tried with successⁿ. The first is, steeping the seeds in water mixed with so much flower of brimstone, as to make it strong of the sulphur^{*}: another is, steeping it in water mixed with a quantity of the juice of horse-aloes. The sowing of foot, or tobacco dust, over the young plants, as soon as they appear above ground, has also been found to be very serviceable; and this may be done very easily along the surface of each drill, if the turneps are cultivated according to the new husbandry, of which I am going to speak; after observing, that caterpillars are another bitter enemy to this plant, which they very often attack even when it is grown so large as to have six or eight leaves. The surest method of destroying these insects is to turn a sufficient number of hungry poultry early in the morning into the field: they will soon devour the insects, and clear the turneps. Those that are sown in drills are least exposed to this evil; because the frequent stirring of the ground between the rows keeps the plants constantly growing, and they are therefore the less injured by these insects.

The worm to which turneps are very liable may be guarded against, at least in a great measure, as Mr. Lisle informs us^o, by liming the ground.

ⁿ *Gardener's Dict.* Art. *RAPA*.

^{*} In the Daily Advertiser of July 11, of this year (1763), is the following receipt, which is there said to be an approved method for preventing the fly in turneps. "Steep the seed in chamber-lye, six hours; then drain the liquor off, and strew the seeds with as much flower of brimstone, or sulphur *vivum*, as will render them dry enough to separate. Let them then be sown in the usual manner." I give my authority; and think that this may be full as likely to succeed, as the receipt certified by Mr. Miller.

^o *Observations in Husbandry*, Vol. II. p. 26.

This

This will also render them much sweeter than they would otherwise be: and I am of opinion that fresh slaked lime strewed over the ground when the turnep seed is sown, will contribute greatly to preserve the young plants from the fly. It is to the worm lodged in the root of the turnep, perhaps engendered from the egg of the fly, that Mr. Lisle imputes^h the distemper or disease in turneps, which the Norfolk farmers call the hanbery; so named from a like distemper in a horse's heel. It is a watery excrescence, formed probably by this insect, in the same manner as galls are formed upon the leaves of the oak. In some years, it takes off the whole corps, and the turneps never thrive after it has begun to grow in them.

A gentleman, remarkable, among many other good qualities, for several excellent improvements which he has made in agriculture, tried with success the following experiment, to preserve turneps from the fly, and the better to secure their growth. He sowed the seed in a nursery, where there was least danger of slugs or the fly, and where they might easily be watered in case of great drought, to make them grow the quicker. They remained in this nursery, till they were large enough to be transplanted. By this means he gained some weeks longer, to perfect his fallow, or give a thorough plowing to ground which had borne a crop that season. He transplanted his turneps into the field, and by planting them regularly at due distances, greatly lessened the expence of hoeing; their regularity making it very easy to destroy the weeds from time to time, as they appeared. If the season is dry, they may be carried from the nursery to the field in vessels full of very moist earth,

^h *Ibid*, p. 36.

as hereafter advised by M. de Chateauvieux, in his directions for transplanting lucerne.

I have just now the pleasure of receiving the Memoirs of the truly laudable Society of Berne for the year 1762, in the second part of which the reverend Mr. Bertrand sets a noble example. Not satisfied with even a scrupulous discharge of the duties of his clerical function, he also instructs his parishioners, his country, and mankind, in the important subject of agriculture. The improving of light soils by the culture of turneps, is one of his objects: upon which he very judiciously observes, that though it be right to plow stiff lands before the winter, in order to their being mellowed by the frost; yet as the finest and best parts of the soil will be in danger of being washed off, or carried down into the loose earth underneath, when this is done in a light ground, or in mould which has a sandy or gravelly bottom; it will be most advisable here, to turn the stubble down immediately after the corn has been taken off, and then to sow turneps: because their spreading leaves will shelter and secure the fine mould upon the surface, and keep the land in good heart, whilst the earth will be loosened and divided by their roots, so that it will be rather fitter for a spring crop, than if it had lain uncultivated.

The chief use of turneps is, to feed cattle in the winter and spring, when there is a want of grass for their pasture. Cows, oxen, and hogs, are very fond of this food, which fattens them, and increases the milk of the former. Sheep too eat it readily, and thrive upon it*, when they

* p. 58.

* Parsley corrects the inconveniences which may arise from the too great moisture and coldness of the turneps, and therefore must be of singular use in wet low pastures, as will be farther noticed hereafter.

have been used to it early; but they do not relish it when it has not been offered them till they are grown old: however, if they are kept fasting two or three days, most of them take to it, and when they have once tasted it, they become very fond of, and feed kindly upon it. In some places they feed their lambs with turneps till the middle of April, though they then begin to run up to feed. Farmers choose rather to do this, than to let them hurt their clover, sain-soin, lucerner, &c. Some par-boil them a little, at first, till their cattle, and particularly their sheep, are accustomed to them^s: but a lamb only three weeks old, will, after it has once eaten of this food, scoop out a raw turnep with great glee.

Turneps, if not clean eaten, and well cleared off the ground, may take root again, run to seed, and do great damage to the ensuing crop. Mr. Lisle instances it^t in a gentleman of Berkshire, who plowed up a turnep field in the spring, and sowed it with peas: but the little dwarf turneps that were left behind, uneaten, notwithstanding his plowing them up, took root again, ran to seed in great quantities, and did much damage to his crop of peas.

The practice of turning a flock of sheep, at random, into a large field of turneps, is very bad: for they will then spoil more in a fortnight, than would keep them a whole winter. The best way, therefore, of feeding them with these roots, is, as Mr. Tull advises^u, and after him M. Duhamel^w, one or other of the three following methods,

^t DUHAMEL, *Culture des Terres*, Tom. I. c. 14.

^s *Idem*, *Eléments d'Agriculture*, Tom. II. Liv. 9. c. 4.

^t *Observations in Husbandry*, Vol. II. p. 35.

^u *Horse-boeing Husbandry*, c. 8.

^w *Culture des Terrés*, and *Eléments d'Agriculture*; *ubi supra*.

which are equally applicable to the drill, and to the common, husbandry.

The first is, to portion out the turnep ground, by inclosing with hurdles so much only as the sheep can clear in one day; and so to advance the folds farther into the field every morning, until all be spent. But it is to be observed, that the sheep never eat them clean this way, but take only the leaves and the heart of the turnep: so that great part of them remains in the earth. It is true that these fragments, if left there, rot, and become a manure: but when they are wanted for the food of the flock, and are to that end pulled up with iron crooks or forks made for this purpose, the sheep do not relish, and consequently eat but little of, these then dirty withered remains, tainted with their urine, dung, &c. nor can they nourish them so well as roots which are fresh and cleanly.

The second method differs from the former only in pulling up the turneps so far as they are hurdled off, before the sheep are turned in. They then eat them better, because the food is fresh and in good condition. Besides, as the whole turneps are pulled up more easily than their pieces can be, there is not such waste as in the other way. The turneps which grow next to the hurdles should be thrown towards the middle of the space hurdled off; because they will be less liable to be trampled upon and spoiled there, than nearer to the hurdle, where the sheep run about most, in search of means of escaping into the open field.

The third way is to pull up the turneps, and carry them into some other ground, and there spread them every day on a new place, where the sheep will eat them up clean. This is done when there is land not far off, which has more need of dung than that where the turneps grow. The expence of carrying the turneps is compensated by saving

saving the price, or at least the carriage and removing of the hurdles: only when the turneps are laid on a spot of grass, as is frequently done in wet weather, the benefit of the dung and urine of the sheep is lost.

This method is requisite when the field on which the turneps grow is wet; because, 1, The sheep would trample upon, and bury, part of the turneps, which would be lost. 2, In treading that wet earth, they would poach it, and render it unfit for corn. 3, By this means, a field may be dunged, as I have just said, which wants it more than that where the turneps grew. 4, This must necessarily be done, if wheat has been sown in the alleys between the rows of turneps, according to the principles of the new husbandry.

Turneps are always carried off the field, when they are intended to fatten the larger sort of cattle: and they should be cut in pieces for them, lest they choak themselves with the whole ones. They are given morning and evening to stall-fed cattle, which in the intervals, eat likewise common fodder: but the turneps increase their appetite to such a degree, that a middle sized bullock, stalled for fattening, will consume near 200 pounds weight of these roots in 24 hours, besides hay; whereas, if nothing but hay were given him, he would hardly eat half the quantity that he will with the turneps. A healthy bullock, in only good plight at the time of his beginning to be fed with turneps, will be very well fattened in three monthsⁿ.

In Norfolk, and some other countries, great quantities of turneps are cultivated for the feeding of black cattle, which turn to great account in the farms where this is practised. The turneps

■ DUHAMEL, *Eléments d'Agriculture*, Tom. II. Liv. 9. c. 4.

are taken off the ground before the land is wetted by the winter rains, and they are laid up in barns, where they keep perfectly well. By this method of feeding cattle, the farmer obtains a good dressing for his land. But Mr. Lisle says ° it has been found by experience, that turneps do not fatten large cattle well after Christmas, because they then grow hollow and sticky; though they will still do very well for folding of sheep.

Some intelligent farmers have, of late, cultivated turneps, by sowing the seed in rows, with a drill plough. The distance between the rows has been different, according as their judgment has suggested, some having placed them three feet, others four, some five, and others again six feet, afunder; and some having sown the rows double, others single. These last, with intervals of six feet between the rows, have been recommended as the best method; and though the intermediate spaces here seem very wide, yet the crop produced on an acre of land sown in this manner, has been much greater than upon the same extent of ground where the rows have been at but half this distance. Certain it is, that the fields in which turneps have been drilled and cultivated with the horse-hoe, have constantly yielded much larger crops than those which have been sown in the common broadcast way, and only hand-hoed.

The late lord viscount Townshend was at the expence of making the trial of these two different methods of husbandry, with the greatest care, by dividing the same field equally into different lands, which were sown alternately in drills, and the intermediate lands in broadcast. The latter were hoed by hand, in the common way, and the others were cultivated with the hoeing plough.

° *Observations in Husbandry, Vol. II. p. 7.*

When

When the roots were full grown, his lordship ordered an equal quantity of land, cultivated in each different way, to be measured, and the turneps to be drawn up and weighed. Those cultivated with the plough were so much larger than the others, that the crop of one acre of the former weighed a ton and a half more than that of an acre in the other husbandry.

Mr. Tull says^p he found by experience, that the best way of sowing turneps is in single rows, six feet asunder. He sowed them in double rows, also at that distance, but they did not do well: and he likewise sowed them in single rows, with intervals of only three feet. These last yielded a greater crop than a neighbouring field which was sown and managed in the common way: but neither the single rows three feet asunder, nor the double rows with intermediate distances of six feet, yielded, says he, half so much, as the single rows six feet asunder: from whence he concludes, that it is best to leave a space of six feet between the rows; for that, if the alleys are well plowed, these turneps will thrive wonderfully, even though no other moisture falls but the dew, which will sink into the earth, to their roots.

However, notwithstanding Mr. Tull's experiment, M. Duhamel is for sowing turneps in double rows, if the intervals are of six feet; or if they are sown in single rows, he would have these rows be but four feet asunder; which is the space left between the rows of vines in Languedoc, and which is there plowed with oxen^q.

An ounce of seed will sow as much land when drilled, as a pound will in the common way: and if care be taken to distribute only the necessary

^p *Horse-hoeing Husbandry*, c. 8.

^q *Culture des Terres*, Tom. I. c. 14.

quantity, a great deal of trouble will be saved in the hoeing of the plants afterwards, to thin them. But it is essential to observe, I must again repeat it, that all roots, whether turneps, carrots, parsneps, parsley, or any other, always thrive best where there is a great depth of fine, light, well loosened mould. M. Duhamel trenched the whole of his kitchen-garden three feet deep: all his pot-herbs grew very fine, and his roots in particular were of a surprizing size ^r.

M. Tull, by drilling his turnep seeds alternately at different depths in the earth, was sure to succeed in one part or other, whether the season was wet or dry. If wet, the seed slightly covered sprouted first; and in dry seasons, that which lay deepest was the first that rose. By this means, and by mixing the seed, half new and half old, for the new always comes up soonest *, he had four comings up, which, as he observes, gave the plants so many chances to escape the fly.

If one was sure of having rain immediately after the turneps are sown, it would undoubtedly be right to sow them very shallow: but if no rain happens, they are best deeper in the earth, because they there meet with moisture sufficient to make them grow.

When the season has been so kindly that all the seeds have grown, and the plants have not suffered by the fly or other insects, they must be thinned early, that the ground may not be exhausted by such as are not intended to remain; for those that are left should be about a foot asunder.

When the turneps sown in drills thrive well, only each alternate alley need be hoed at one time, and the others a few days after; it being better

^r *Ibid.*

* Mr. Tull says the difference is a day.

to feed the plants gradually, by dividing the hoeings in this manner, then to give them a great deal of food at once, by hoeing all the alleys together, and afterwards leave them double the time without any culture at all. Another advantage attending this method is, that the plants will be the less liable to be killed by hot dry weather, and the less apt to be damaged by heavy rains. But it will not, indeed, so effectually destroy weeds, which ought always to be a principal object of the husbandman's care, and which ever is one of the chief intentions of the new husbandry. However, as all weeds are very apparent in the alleys, it is easy to extirpate them there; and as to those which may chance to be in the rows, the person who thins the turneps may cut them up at the same time. He will there most easily distinguish the charlock from the turneps, especially when the leaves of these last are come to be about the breadth of a half crown.

By this alternate hoeing of the alleys, the plants will be the less exposed to suffer from the earth's being thrown up too high on some rows, while others may be left too bare: for when the earth has been thrown up on one side of the drill, it may be turned down again before the next interval is hoed.

An expert husbandman will bring the horse-hoe to within two or three inches of the plants: but as this instrument cannot plow between them in the rows, the remaining ground there should be forked, to loosen the parts, and make room for the fibres of the roots to strike out into the intervals: otherwise, if the land is strong, it will become so hard in those places which are not stirred, as to stint the growth of the turneps. This may be done at a small expence, and in very little time, as the other hoe has before stirred all the

rest of the ground: and Mr. Miller answers, as doth reiterated experience, that whoever practices this will find his account in it, especially on all strong land, where the turneps are most liable to suffer from the binding of the ground: though it will be of signal service in every soil; for the frequent stirring of the earth will not only greatly improve the plants actually growing on it; but, as I have constantly endeavoured to inculcate, it will prepare the ground admirably for the succeeding crop.

All plants sown in single rows are greatly benefited by this alternate hoeing of the alleys between them: for, as M. Duhamel observes^s,
 1. Four of these hoeings, which cost no more than two entire ones, are almost as beneficial to the plants as four complete hoeings. 2. A plant which finds a great deal of nourishment on one side, is the better able to thrive without receiving so much on the other. 3. If, in hoeing very near the plant, some of it's roots are broken; those on the other side, not hoed, supply the wants of the plant, till the broken ones have made fresh shoots. 4. The horse-hoe may therefore be brought very near to the turneps, without fear of hurting them; provided it do not force them out of the earth. 5. When a farmer has a great quantity of turneps to hoe, they are sooner supplied by this culture, than they could possibly be if all the alleys were to be hoed.

A furrow should not be left open near the turneps, while they are young; because the earth about them would in that case become too dry: but there is no danger of this in the autumn, when they are grown strong, and the earth is moist. Neither is it adviseable to leave a furrow open

^s *Culture des Terres, Tom. I. p. 168.*

near them during the winter; because they would be in danger of being hurt by the frost.

When these plants are grown large, and their roots are consequently pretty well extended, the hoe-plough need not come quite so near them as at first: nor is it necessary to hoe them at all, till they are about the bigness of one's finger's end.

One alternate hoeing, or, which is the same thing, two half hoeings, will be sufficient when the turneps are sown late. But when they are sown early, and many weeds grow, one hoeing will not be enough.

By following this culture, M. Duhamel has seen turneps which weighed from sixteen to nineteen pounds; and we may depend on* their weighing one with another, twelve pounds a-piece in a good soil, which is a vast produce from an acre of land. Mr. Miller says, that one acre of turneps, thus properly cultivated, will afford more feed for sheep or ewes in the winter, than fifty acres of the best pasture at that season.

Another vast advantage which attends the sowing of turneps in rows, is, that instead of occupying the whole ground when it should be sowed with wheat, and sometimes even when it should be sowed with spring-corn, as is frequently the case in the old way; they are no hindrance to either in the new husbandry: for as the alleys are in good tilth, three rows of corn may be sown, seven inches asunder, between the rows of turneps; and when these roots are pulled up, the ground where they grew is hoed, and becomes the alleys between the beds of corn.

The best turnep seeds are obtained from the largest roots, which may either be transplanted for that purpose, or marked out in the field where

* *Ibid.* p. 170.

they

they were sown. Those which are commonly sold in the shops, seldom produce the finest plants.

I shall close this article with the following

Experiments on Turneps cultivated according to the New Husbandry.

IN 1754, M. de Chateaufvieux sowed turneps on beds, in two rows^u. They suffered greatly for want of rain, and none of them grew to the size they would have done in a more favourable season. Some of them weighed eight pounds; but their general weight was from three to four.

In 1755, M. de Chateaufvieux sowed some beds with one row,* some with two, and others with three rows^x. They were afterwards thinned, so that the plants stood a foot asunder in the rows. Those sown in one row were the largest, and, in general, the most equal. Some of them weighed fourteen pounds, and most of them from seven to eight. In the other rows, they did not weigh so much; but they were more numerous.

In consequence of these experiments, M. Duhamel, to whom they were communicated, makes the following striking calculation relative to the quantity of food which turneps will afford for cattle^y.

“ Let a square whose side is 216 feet be formed into beds four feet wide, which is sufficient for one row of turneps. These will be 216 feet long, and consequently will contain that number of turneps, planted a foot asunder. These 216 multiplied by 54, the number of beds, will give 11664 turneps for the product of the square; and these multiplied by six, the supposed weight of each turnep,

^u DUHAMEL, *Culture des Terres*, Tom. V. c. 5.

^x *Ibid.* Tom. V. p. 547.

^y *Culture des Terres*, Tom. V. c. 5. p. 547. and *Eléments d'Agriculture*, Tom II. Liv. 9, c. 4.

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will give 69,984 pounds for the weight of all the turneps on this spot." This may be looked upon as a very considerable crop; for it will be sufficient to stall-feed four bullocks during the three winter months, at the daily allowance of 200 pounds each: and yet there is reason to believe that the quantity will be doubled in a good year, as will be pretty evident to those who consider at how low a rate the medium weight of the turneps is here estimated.

In 1755, M. Duhamel sowed turneps in a field, on beds cultivated with the horse-hoe. They grew extremely fine; many of them being 29 inches in circumference.

ARTICLE II.

Of Carrots, Parsneps, and Parsley.

I Class these together, because their culture is alike.

The Flemings have long known the advantage of feeding their cattle with *Carrots*, though it be but of late years that this root has been cultivated for that purpose in the fields in England: nor does this useful and profitable practice extend even now to more than a few parts of this country; though there is scarce any root yet known, which is more heartening food for most sorts of animals, or which better merits the husbandman's attention, if Mr. Miller be right, as I believe he is, in saying^a, that one acre of carrots, well planted, will fatten a greater number of sheep or bullocks, than three acres of turneps, and that their flesh will be firmer and better tasted. Horses are extremely fond of this food, and there is not any

^a *Gardener's Dict.* Art. DAUCUS.

better

better for hogs. These roots have also been of such excellent service to deer, in parks, that when numbers of these valuable creatures have perished elsewhere, through want, in very hard winters, when there has been an extreme scarcity of their usual food; those that have been fed with carrots have kept their flesh all the winter, and, upon the growth of the grass in the spring, have been fat early in the season. This is not an inconsiderable advantage in places where the grass is generally backward in its growth.

But another, and that a very great, superiority which this plant has over turneps, is, that the crop is not so liable to fail: for as the carrots are sown in the spring, the plants generally come up well; and unless the months of June and July prove very bad, there is no danger of their succeeding: whereas turneps are frequently destroyed by the fly at their first coming up, and in dry autumns they are attacked by caterpillars, which lay waste whole fields in a short time. But carrots are not preyed upon by either of these vermin. Every farmer who has a stock of cattle or sheep should therefore always have good store of these roots. His land will be fit for them, if it is in the proper tilth before directed.

Here I must again make one particular, as well as general, observation, which is, that for carrots, and all tap-rooted plants, the ground should be plowed as deep as the nature of the soil will permit, and brought to as fine a tilth as possible; for the more this is done, the thicker and longer the plants will be.

One pound and a half of seeds, which should be sowed in March, will be sufficient for an acre of land. These seeds are so very apt to cling together, that they are more difficult to sow than almost any others. Mixing them with a quantity of dry sand,
and

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and then rubbing the whole well together, is as good a way as any to separate them. After they are sown, they must be lightly harrowed in, to bury them; and when the plants are come up, they must be hoed and thinned, so as to be left ten inches or a foot asunder. The hoeings must be repeated frequently, to keep them clear from weeds, and no other crop should ever be sown with them, if it be intended that they should have large roots fit for fodder; unless it be parsneps, which require the very same culture, and which may be profitably used for the same purpose.

The horse-hoeing husbandry, managed as before directed for turneps, will make them grow to a surprising size. M. de Chateauvieux has given us a proof of it in the following part of an experiment which he made in order to satisfy himself whether pot-herbs, in general, may not be cultivated in the same manner as wheat is in the new husbandry, without dung, and without the expensive labour and attendance bestowed upon them in the common way.

Of three beds^b, each forty feet long and six feet wide, he sowed two with carrots, and one with beets. The plants were thinned where they grew too thick, so as to leave a distance of seven or eight inches between the carrots, and 14 or 15 inches between the beet-roots. Though neither of these was ever watered (for such is the excellence of the new husbandry when properly executed, that ground perfectly loosened to a good depth, always retains moisture enough for the plants upon it), the leaves of the beets were three or four inches broader than those of the same kind of plants in his kitchen garden (which had been well dunged); and though the rows were six feet asunder,

^b DUHAMEL, *Culture des Terres*, Tom. II. part 3. c. 1. p. 333.
the

the leaves of the carrots met in many places, in the middle of the furrow between the beds.

The beet-roots, which I have purposely retained in this experiment, because I think it may be well worth while to try whether they will not be very good food for cattle, were dug up on the 25th of October, and were all nearly of the same size, which was from 5 to 6 inches in diameter towards their top or thickest part.

The carrots were dug up on the 8th of November, and, to the astonishment of M. de Chateauvieux's gardener, who would have betted all he had in the world, that the crop would not be worth digging, they measured from 18 to 20 and 25 inches in length, and from $2\frac{1}{2}$ to $3\frac{1}{2}$ and 4 inches in diameter, and weighed from 25 to 30 and 33 ounces each.

To preserve the carrots for use all the winter and spring, they should be dug up about the beginning of November, when their green leaves are decayed, and they should then be laid in dry sand, in a dry place, where the frost cannot reach them, in order to be taken from thence as they are wanted.

Some of the longest and straightest roots may be reserved for seed, if it be intended to save any; and in this case they should be transplanted in the spring into a light, and deep soil, where they should be planted about a foot asunder every way. This ground must be kept very clear of weeds; and when the seed is ripe, which will be about the middle of August, it must be cut off, and carried to a dry place, where it should be exposed to the sun and air, for several days, to dry: it may then be beaten out, put into bags, and laid up in a dry place. This seed is seldom thought to be very good after the first, or at most the second year: nor indeed will it grow after it is more than two

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two years old. New seed is therefore always preferred.

Parsneps are another excellent, wholesome, and very nourishing food for cattle. Their culture, as I have just observed, is exactly the same as that of carrots, with which they may therefore be sown in the same ground. Their leaves will decay at nearly the same time, when the roots may be dug up, and laid by for use, likewise buried in dry sand, in a dry place.

Parsnep seeds seldom grow after they are above a year old.

It has long been a custom in some parts of Brittany, to sow parsneps in the open field for the food of cattle; as we are informed by the first volume of the transactions of a Society instituted in that province, for the encouragement of the economical and commercial interests of their country. "It is of great importance," say they, "that parsneps should be universally cultivated; because they afford an excellent and wholesome food for all kinds of cattle, during the winter, and may be used to great advantage to fatten them. Our hogs have no other food in all that season, and our bullocks and oxen thrive well upon it. Our cows fed with parsneps give more milk than with any other winter fodder, and that milk yields better butter than the milk of cows nourished with any other substance. Our horses fatten with this food; though some pretend that it renders them less mettlesome, and hurts their legs and eyes.

"Cattle eat these roots raw at first, sliced lengthwise; and when they begin not to relish

c Corps d'Observations de la Société d'Agriculture, de Commerce et des Arts, établie par les Etats de Bretagne. Années 1757 & 1758, p. 88.

"them,

“ them, they are cut in pieces, put into a large
 “ copper, pressed down there, and boiled with
 “ only so much water as fills up the chasms be-
 “ tween them. They then eat them very greedily,
 “ and continue to like them.”

The common garden *Skirret* (*Sium*, or *Sisarum*) may likewise, probably, do well for cattle; for it is a very nourishing root, and has a sweet taste. It's proper culture is exactly the same as that of parsneps and carrots, and there is no doubt of it's succeeding admirably in the new husbandry; for M. de Chateauvieux's skirrets, cultivated with the hoe-plough, in an open field, were larger and more fleshy at the end of six months, than those in his kitchen-garden were at the end of nineteen; even though the former had been damaged by slugs ^b. The latter end of March, or the beginning of April, is the best time for sowing them; and if the seeds are good, they will appear in five or six weeks after they are sown.

Parsley is known to be so excellent a preservative against the rot in sheep, if they are fed with it twice a week, for two or three hours each time, that I cannot but regret the want of experiments on the culture of this useful plant, which would certainly succeed well in rows properly hoed, and prove a general benefit. The few skilful persons who have raised it in the field for the use of sheep, have found it turn to great account, though sown only in the common broad-cast way. How much then may be reasonably expected from it's greater increase, and more perfect quality, when cultivated according to the principles of the new husbandry! For that plants do attain a much higher degree of perfection in this way, than in the old method, has been constantly evinced, by frequently repeated,

^b DUHAMEL, *Culture des Terres*, Tom. II. p. 340.

and always unvaried, experience. I therefore strongly recommend this object to the British farmer, whose flocks, superior to those of every other country, are a principal source of the wealth and grandeur of this happy land, as well as a valuable treasure to the individuals who possess them. It is likewise possible, or rather, perhaps, highly probable, that, as Mr. Worlidge observes in a letter to Mr. Houghton^c, on this subject, besides preventing or curing the rot*, the taste of the mutton may also be improved by this pasture; for it is very certain, that the flesh of all animals acquires a peculiar flavour from their food. This is particularly remarked in venison: and it is as invariable, that the sweetest mutton is that which has been fed on the finest and sweetest grasses, as is experienced on the peak in Derbyshire, the plains of Wiltshire, Hampshire, &c. and the downs of Dorsetshire, Banstead, &c. whilst, on the contrary, the coarsest and rankest mutton is produced from the grossest meadows and marshes.

The best time for sowing parsley in the field, is about the middle or latter end of February. The ground cannot possibly be in too fine tilth. Mr. Miller^d mentions two bushels of seed as a proper quantity for an acre of land sown pretty thick in drills about a foot asunder, which will, indeed,

^c HOUGHTON'S *Collection*, Vol. IV. No. 12.

^d *Gardener's Dict.* Art. APIUM.

* This disease is occasioned by the sheep feeding on too much cold and moist meat, such as turneps, clover, and large rank grass in low lands: it is best remedied by hot and dry food; and such parsley is in a very high degree. For the same reason, those that feed in shady places, in some grounds, where the dew lies long on a certain broad grass, necessarily incline to the rot; and this is prevented by turning them into salt marshes and brackish ground, or giving them salt with their dry food: for salt is esteemed a cure for this disease. *Worlidge*, in *Houghton's Collection*, Vol. IV. No. 12.

be space enough for hand-hoeing: but I am inclined to think, that the plants will flourish best, grow largest, and be in all respects most perfect, if the distance between the rows is sufficient to admit a hoe-plough. Less seed will then be requisite, the culture will certainly be performed cheaper this way, than by hand, and I am confident that the plants will be larger, and better for the food of cattle. The roots of the common great garden parsley will grow, in this way, to be at least the size of a middling parsnep. These roots may also be boiled, and eaten, as young carrots; for they are very palatable and wholesome, especially for those who are troubled with the gravel. The Dutch are very fond of them for their *Water fouches*.

Hares and rabbits are so fond of parsley, that they will come from a great distance to feed upon it; so that whoever chuses to have plenty of those animals in his fields, need only stock them well with this plant: he will soon draw to them all the hares of the country: but, at the same time, if his parsley is not fenced in very securely, they will be sure to destroy it.

Let us now consider the manifest advantage of cultivating carrots and parsneps for the food of cattle.

On a bed six feet wide, three carrots will take up a space of 13 square feet: consequently the acre will yield 10,890 carrots: and supposing each carrot to weigh but 28 ounces, which is rather under the medium weight of the carrots in M. de Chateauvieux's experiment, the above number will weigh 19,000 pounds. Now a bed of six feet wide may, with great propriety, admit two rows of carrots, a foot asunder; and in this case the produce will be nearly double. Or if we suppose the acre to be divided into beds four feet wide, it will

*CARROTS, PARSNEPS, AND PARSLEY. 181

will contain 16,335 carrots, which, at 28 ounces each, will weigh 28,586 pounds.

As carrots are much more substantial than cabbages, which will be spoken of in the next section; as proper for the food of cattle; and as they are also more substantial than even turneps; cattle will, undoubtedly, eat proportionably less of them: but as the quantity which they will eat of this root has not been ascertained by experiment, I can make no estimate thereof; but rest satisfied that Mr. Miller has some facts to go by, when he says, that one acre of carrots will feed more cattle, than three acres of turneps.

The people of Flanders have found by long experience, that carrots agree singularly well with horses, and that these creatures require much less corn when they are fed with them, than when they are fed with hay. Supposing, then, that a horse can eat 50 pounds of carrots in a day; 28,586 pounds of carrots, the above product of an acre planted in beds four feet wide, will maintain two horses, near ten months, with half their usual allowance of corn.

If we consider that parsneps grow rather larger than carrots, and that they are yet more nourishing and substantial; what has been said of the quantity of carrots on an acre of land, and of their use, may justly be applied to parsneps. This is confirmed by the estimation set upon a crop of parsneps in Britany, where it is reckoned equal in value to three crops of wheat, even when an acre of this corn yields about four quarters^c. Another advantage arising from these roots, is that they leave the ground prepared for any sort of spring-corn.

^c *Observations de la Société de Bretagne, pour les années 1757 & 1758. p. 90.*

ARTICLE III.

Of Potatoes.

MR. Houghton describes the potatoe* to be a bacciferous herb, with esculent roots, bearing winged leaves and a belled flower; and says, that, according to his information, which is allowed to be very right in this respect, it was first brought from Virginia, by Sir Walter Raleigh†, who, stopping at Ireland, gave away a number of these roots, which were planted there, and multiplied so exceedingly, that, in the wars which happened afterwards in that country, when all the corn above ground was destroyed, potatoes became the chief support of the people: for the soldiers, unless they had dug up all the ground where they grew, and almost sifted it, could not have extirpated them. The Philosophical Transactions observe likewise‡, that the Irish were relieved from their last severe famine, which lasted two years, during which all their corn failed, merely by the help of this root. From Ireland it was brought to Lancashire, now famous for its potatoes: and the culture of this plant has, within these last thirty years, been extended to almost every part of England. The rich, who, at first, deemed them fit for none but the meaner sort of people, now esteem them so much that, Mr. Miller thinks§ the quantity of them which is cultivated around

* Which is C. Bauhin's *Solanum tuberosum esculentum*, Esculent tuberous Nightshade. The name *Potatoe* is evidently a corruption of the Indian *Batatas*.

† About the year 1623.

‡ No. 90 and 134.

§ *Gardener's Dict. Art.* LYCOPERSICON.

London only, exceeds that of any other part of Europe.

The red rooted potatoes have purplish flowers, and the white rooted (for Mr. Miller distinguishes only these two general varieties) bear white flowers.

The potatoe seldom perfects it's seeds in England; and if it did, the raising of it from them would be much more tedious and uncertain than propagating by its roots, as is the general, and right method: for these multiply exceedingly, and may be made to yield vast crops, with little cost, or labour.

As Ireland is famed for it's crops of potatoes; as the culture of this plant has been longer and more universally practised there than with us, or any other European nation; and as the Irish have always, very judiciously, looked upon this article as an object of great importance; it may naturally be supposed, that their husbandmen excel in this respect. The reader may therefore not be displeased at the means of comparing their practice with the improved method which Mr. Miller advises. I shall transcribe the former from the account which Mr. Switzer says he received from a gentleman of good intelligence, and who was also a husbandman, then lately arrived from Ireland; and the latter from Mr. Miller's elaborate dictionary.

"The Irish husbandman^h, after blaming the English for planting this root uncut, because it often contains five or six eyes, or perhaps more, from which the produce of the ensuing year is to spring; and also for not allowing that bulb, or rather the great number of shoots and bulbs that proceed from it, a space of earth sufficient for their

h SWITZER'S *Practical Kitchen Gardener*,

nourishment, which is the reason why so many poor, stunted, unserviceable, potatoes are dug up in the autumn, relates the practice of his country, which is, to choose middle sized roots, for the largest are generally eaten, to single out the eyes that seem strongest and most vigorous, and to cut them out in squares of at least half an inch every way: so that one root will sometimes furnish three or four good pieces to set.

“ The ground, prepared for planting, is marked out for beds four or five feet wide, with intermediate alleys of two or three feet. It is then trenched, only a single spit deep, and the bottom of this trench, made as in common garden trenching, is covered with dung, long and short, taken out of a wheel-barrow which stands at the labourer's elbow. The potatoe-eyes, cut as before directed, are placed upon this dung, at about five or six inches asunder; and this trench is filled up with the mould taken out of the next, which is marked by a line at the distance of two or three feet. This trench is again filled with the mould of the next, and so on to the last, which is filled from the alley.

“ The use of the dung thus laid at the bottom of the trenches, is not only to make the roots grow single, for not above one root, or at most two, will in this case be produced by each eye, and these will be large and well fed; but it is attended with the farther advantage of making the potatoes run, and spread themselves to a certain determinate depth, which is no small help to their growing large.

“ The last thing to be done to them is, in April or May (for they are planted in February or March), as soon as they begin to rise, to dig the earth out of the alleys, as is done for asparagus, and to cover the potatoe bed with it, about
five

five or six inches thick. This will give new life and vigour to the roots, will keep the green from running too much to haulm, and will make the bulbs grow much the larger. By this means the crop of fine large potatoes will be almost the double of what is obtained when they are planted promiscuously in the common way: nor will any farther culture be requisite till they are fit to be dug up; except the pulling out of some of the largest weeds."

Mr. Miller's reasonsⁱ for disapproving of the planting, either of the small offsets entire, or the eyes cut out of larger roots, are, that though the former generally produce a greater number of roots, these roots are always small; and that the cuttings of the larger roots are apt to rot, especially if wet weather happens soon after they are planted. He therefore recommends, to make choice of the fairest roots for setting; and to allow them a larger space of ground, both between the rows, and between the plants in the rows; and he assures us that he has observed, when this method has been followed, that the roots, in general, have been large the following autumn. M. Duhamel, in his *Elements of Agriculture*^k, does not object at all to the planting of the cuttings.

The soil in which this plant thrives best, is a light sandy loam, neither too dry nor over moist, but brought to a fine tilth, and plowed very deep; for the deeper the earth is loosened, the finer and larger the roots will grow. In the spring, just before the last plowing (I am giving Mr. Miller's method), a good quantity of rotten dung should be spread on the ground, and this should be plowed in early in March, if the season be mild; other-

ⁱ *Gardener's Dict.* Art. LYCOPERSICON.

^k *Tom. II. Liv. 9. c. 4.*

wife it had better be deferred until the middle or latter end of that month; for if a hard frost should come on soon after the roots are planted, they may be greatly injured, if not destroyed, thereby; but if they can be planted in the spring, without that danger, the better it will be.

The last plowing should lay the ground even, and then furrows should be drawn three feet asunder, and seven or eight inches deep. The roots should be laid at the bottom of these furrows, about a foot and a half asunder, and they should then be covered in with earth.

After all the ground intended for potatoes is planted in this manner, it must remain in the same state till near the time when the shoots are expected to appear: then it should be well harrowed both ways, as well to loosen the surface and render it smooth, as to tear up the young weeds which will have begun to grow by that time. If much wet has fallen after the planting, it may have caked the surface of the earth, so as to retard the sprouting of the plants; and this harrowing will, in such case, almost answer the intent of a first hoeing.

I have placed the rows of potatoes at three feet distance, continues Mr. Miller, in order to introduce the hoe-plough between them; because that will greatly improve their roots: for by twice stirring and breaking of the ground between these plants, not only weeds will be destroyed, but the soil will be so loosened, that every shower of rain will penetrate to the roots, and greatly quicken their growth. But these operations should be performed early in the season, before the stems or branches of the plants begin to fall and trail upon the ground: for after that, it cannot be done without injuring the shoots*.

If

* The first horse-hoeing should be given when the plants are about five or six inches high, and the second when they are about

If these hoe-plowings are carefully performed, they will prevent the growth of weeds, till the haulm of the plants covers the ground; and after that there will be little danger of their growing so as to injure the crop; for the haulm will keep them under: but as the horse-hoe can only go between the rows, it will be necessary to make use of an hand hoe to stir the ground, and destroy the weeds in the rows, between the plants. If this is well done, in dry weather, immediately after each of the two horse-hoeings, it will be sufficient to keep the ground clean until the potatoes are fit to be taken up; which will be very soon after the first frost in the autumn has killed the haulm. They should not remain much longer in the earth, lest the roots themselves be frost-bitten, which spoils them. A four or five pronged fork is better to dig them up with, than a spade, because it is less apt to cut them: but a principal thing to be considered here, is the clearing of the ground thoroughly of them: for if any are left, they will shoot up among the next crop, whatever it be, and do considerable damage, especially if it be wheat, as is generally the case, sown in the common broad-cast way.

The best way of keeping these roots during the winter, is, as before directed for carrots and parsneps, to lay them up in a dry place in very dry sand, or in fine and perfectly dry earth.

The method of laying dung only at the bottom of the furrows in which the roots are planted, " is a very poor one, says Mr. Miller, because, " where the potatoes begin to push out their " roots, they are soon extended beyond the width

about twelve or fifteen; and at each of these the rows should be earthed up, but with great care not to cover any of their stalks.

DUHAMEL, *Eléments d'Agriculture*, Tom. II. Liv. 9. c. 4.

" of

“ of these furrows, and the new roots are commonly formed at a distance from the old: so
“ will be out of the reach of this dung, and consequently will receive little benefit from it.”—
But rather the contrary would seem to be the case, according to the Irish husbandman, who, I suppose, speaks from experience, when he says, as if he had intended expressly to answer this very objection, that “ the dung is placed at the bottom
“ of the furrows on purpose to make the roots grow single; and that its being so placed is attended with the farther conveniency of making
“ the potatoes run, and spread themselves at a certain determinate depth, which is no small
“ help to their growing large.”—Facts must here determine which is right: as they also must in regard to some parts of what Mr. Miller adds in the following words. “ As most farmers covet
“ to have a crop of wheat after the potatoes are taken off the ground, so the land will not
“ be so thoroughly dressed in every part, nor so proper for this crop, as when the dung is
“ equally spread, and plowed in all over the land, nor will the crops of potatoes be so good. I
“ have always observed, where this method of planting the potatoes has been practised, the
“ land has produced a fine crop of wheat afterward, and there has scarce one shoot of the potatoe
“ appeared among the wheat, which I attribute to the farmers planting only the largest roots:
“ for when they have forked them out of the ground the following autumn, there have been
“ six, eight, or ten large roots produced from each, and often many more, and scarce any
“ very small roots; whereas, in such places where the small roots have been planted, there has
“ been a vast number of very small roots produced, many of which were so small, as not to be discovered.”
“ covered

“covered when the roots were taken up; so have
 “grown the following season, and have greatly
 “injured whatever crop was on the ground.”

Will not a thorough plowing and good harrowing, after the crop of potatoes has been taken off the ground, intermix the dung laid in the furrows, and the contiguous earth most impregnated thereby, with the rest of the soil; perhaps almost as well as if the dung had been spread equally over the whole field, at the very first? If it will, the presumption seems strong in favour of the Irish method. For certain it is, that the land ought to be well plowed and harrowed after the potatoes are removed, before it is sown with any other crop; unless the seed for that crop, which generally is wheat, be sprinkled by hand between the rows as they are dug up, and there covered with the earth then turned over. This is practised in some parts of France; but, as M. Duhamel observes^m, the grain is so apt to be distributed unequally in this method, that it is better to plow the ground and sow it, in the regular way.

If the farmer apprehends that his land has not been thoroughly cleared of the potatoes, and is therefore afraid of their damaging his ensuing crop; his best way will be to lay it up very rough against winter, because the frosts of that season are known to kill and rot all potatoes in the ground exposed to them, and it will at the same time be thereby finely prepared for spring corn; especially as it will have been well enriched by the haulm of the potatoes lying upon it.

Though potatoes delight most in a light sandy loam, neither too dry, nor over moist, as was observed before; yet Mr. Maxwell saysⁿ he has seen

^m *Eléments d'Agriculture, Tom. II. Liv. 9. c. 4.*

ⁿ *Miscellaneous Papers on Husbandry, p. 165.*

them thrive well on ground that seemed to be very bad; even in deep moss, which could not bear horses to plow it, but which is considerably bettered by them; and on coarse heath, where they were succeeded by grain, without more dung than was laid on at first. Of so improving a nature are they, and so much is the land enriched by the rotting of their stalks among it, and the digging it gets in raising them.

Several experiments communicated to M. Duhamel concur to prove the extraordinary increase of potatoes cultivated with the horse-hoe: but as this will always be the consequence of the new husbandry, where it is properly used, I shall only borrow from him, on this occasion, M. de Villier's account of his method of practice, because it is the clearest and most concise.

“ There are, says he^o, several sorts of potatoes.
 “ That which I cultivate is the middle sized. It
 “ is planted about the end of April, or the beginning of May, and it ripens in October. My
 “ beds are five feet wide.” I give them two
 “ plowings in the spring; at the second of which
 “ I half-fill the main furrow. Before I plant, I
 “ cut a small furrow with the single cultivator,
 “ which likewise loosens the earth; but if it be
 “ moist, I put a double spring-tree bar to the cultivator, to avoid the poaching of the horses. I
 “ then plant the potatoes a foot asunder in the
 “ row; choosing for this purpose such as are about
 “ the size of a walnut. They are thrust in by
 “ hand, two or three inches deep; and if the
 “ mould does not then cover them sufficiently of
 “ it's own accord, a little more is pushed down
 “ upon them.

° DUHAMEL, *Culture des Terres*, Tom. V. c. 1. §. 14.

“ A slight hand-hoeing can hardly be avoided afterwards, to destroy the weeds which spring up at the same time as the potatoes : but this hoeing need not extend farther than three or four inches on each side of the row ; because the plow will do the rest.

“ I give the first hoe-plowing in the spring, as for wheat ; but earlier or later, according to the condition of the ground.

“ My second hoe-plowing is given as soon as the plants are tall enough to be earthed up ; that is to say, when they are eight or ten inches high. I then turn the earth up towards them as much as possible.

“ As this plant spreads greatly, and shoots out very fast, it would be impossible to give more than two of these hoeings, if one should neglect to take advantage of the time when its leaves and branches do not entirely cover the bed.

“ The roots are dug up in October, or perhaps somewhat earlier or later, according to the season, with a strong iron prong ; shaking and clearing them well from the mould. They are then left to dry for some hours, and are afterwards laid up in a place where the frost cannot reach them.

“ This fruit, which yields surprisingly, is of great service to feed and fatten cattle, especially when it has been boiled a little. They like it very well raw, after it has been kept a few months above ground : but it is best for them after it has been boiled.”

S E C T. II.

Of Plants whose Leaves and Seeds are used for the Food of Cattle.

A R T I C L E I.

O F C A B B A G E S.

THE common large curled colewort, or borecole (*Brassica fimbriata maxima*), and the perennial colewort (*Brassica arborea seu procerior ramosa*), are the species of cabbages most commonly, and most properly, cultivated for the food of cattle. The refuse leaves of all the other sorts of this plant do very well for them, but these are the best for raising in the field, because they are by far the hardiest, the most able to resist frost, and therefore the fittest to yield green food in the spring, when there is a scarcity of herbage. The common colewort is indeed so hardy, that no frost will destroy it; and the perennial puts forth many shoots from it's sides, after it has run up to seed, which is not till the end of two years. This will last three or four years in poor land; but not so long in rich soils.

The best way of cultivating these plants in the field, is undoubtedly by the horse-hoeing husbandry, which makes them thrive amazingly, as will be seen by the experiments hereto annexed: and in this case the best time for sowing them is about the beginning of July, and especially in moist weather, for this will bring up the plants in about ten days or a fortnight. When they have got five or six leaves, they should be hoed and thinned as before directed for turneps, carrots, &c. so as

to let them have full room to spread in the rows, the distance between which should be sufficient to admit the working of the hoe-plough. The hoeing should be performed in dry weather, the better to kill the weeds, many of which will be apt to root again, if rain falls on them, and they are not carried off the ground. About six weeks after this, the plant should have a second hoeing, with the cultivator, or horse-hoe, in the alleys, and by hand between the cabbages in the rows. If this is carefully performed, likewise in dry weather, all the weeds will be extirpated, the ground will be thoroughly cleaned, and the plants will not require any farther culture. In the spring, they may either be drawn up, and carried off the field, to feed the cattle; or, which is the practice of some places, the cattle may be turned in to feed upon them as they stand: but the former method is far preferable, because that will occasion little waste; whereas, when the cattle are turned in among the plants, they tread down and destroy more than they eat, especially if they are not fenced off by hurdles. I need not repeat here, that the hoe-plough, or cultivator, should be brought as near to the plants as it can be, without hurting them, and that the earthing up of the plants, with care, however, not to bury any of them too deep, will make them grow with redoubled vigour.

The fly and the caterpillar are as formidable enemies to cabbages as they are to turneps. Whatever prevents or destroys them in the one, will be equally serviceable for the other: but of all the means yet tried to answer this end, none has succeeded better than fine tillage, keeping the ground free from weeds, and frequently stirring it, according to the principles of the new husbandry.

Mr. Miller allows nine pounds of seed for an acre of land; meaning, I suppose, in the common way of sowing it: for I apprehend a less quantity will be sufficient to drill that extent of ground in rows five feet asunder, or even four feet, which is the least that can here be allowed for the hoe-plough. It is true, that, as he observes, cabbage-seed is very cheap: but this is no reason for crowding the plants in the rows, even at their first coming up; though it will be right to make a considerable allowance for what may be destroyed by the fly and caterpillar. When they are large, less than two feet distance from each other, in the rows, would cramp them too much, and prevent their attaining to their full size.

I here speak, in general, of the common sorts of cabbages usually cultivated in this country; and not of the cabbage shrub, or tree, as it is sometimes called, which grows in the province of the Lower-Maine, in France^b, of which the excellent Marquis of Turbilly has, most obligingly, sent a parcel of the seeds, from Anjou, where he has likewise propagated it to our Society for the Encouragement of Arts, &c. who, with the patriotic spirit which characterises this illustrious assembly, have just ended the public distribution of them, pursuant to the donor's generous intention, to such as have applied, in order to their being cultivated here*.

The extraordinary size of this plant, which will grow ten feet high, with leaves proportionably numerous and large, added to its lasting two years;

^b *Maison Rustique*, Tom. I. Part. 2. Liv. I. c. 11. p. 677.

* We have already seen (*Vol. I. p. 161*) with what superior judgment this nobleman improved a forsaken bog, and raised upon it, besides excellent beans, peas, potatoes, turneps, and carrots; well tasted cabbages, which, though only of the common large hard sort, weighed forty pounds a-piece.

secure success to those who shall cultivate it properly, even though it be only for the food of cattle: but the Marquis assures us, that it is also the tenderest, the soonest boiled, and the sweetest tasted, of perhaps any kind of cabbage. The right way of gathering these leaves is, always to strip off the undermost, as the plant grows; for the head of this cabbage should never be taken off†: and our reason tells us, that the horse-hoeing husbandry will best supply it with a sufficiency of food, in a fine, deep, and well loosened soil.

Mr. Miller advises ‡, as the best method to save the seeds of all sorts of cabbages, (of which there are very many kinds, chiefly cultivated for the table), to single out the finest plants, to dig these up about the end of November, then to carry them to a shed, or other covered place, to hang them up there by their stalks for three or four days, that the wet may drain from between their leaves, and then to re-plant them, in a border of fine well loosened mould, under a hedge or pale, so deep as to leave only the upper part of the cabbage itself above ground, and even this should be earthed up almost to it's very top, unless the earth be wet. In this case, indeed, the whole head of the cabbage should stand pretty much above the surface of the ground, for fear of it's rotting.

If the winter should prove very hard, a little straw, or peas-haulm, should be spread lightly upon these cabbages, to secure them from the frost; but it must be removed as often as the weather proves mild, lest they should rot by being kept

† The head of the common curled borecole, or colewort; may be cut off in the winter, without any danger; and it's stem, if left standing in the ground, will put forth fine lateral shoots in the spring, fit for the seeding either of men or cattle, or for being left to run to seed.

‡ *Ubi supra.*

too close. In the spring of the year, these cabbages will shoot out strongly, and divide into a great number of small branches, the principal of which must then be supported, either with props, or rather by being tied up to sticks, to prevent their being broken off by the wind: and if the weather should be very hot and dry when they are in flower, they should be refreshed with water once a week all over their branches; for this will greatly promote their feeding, and preserve them from mildew.

When the pods begin to turn brown, it will be right to cut off the top of every shoot, with the pods thereon; for this will strengthen the remaining seeds: and indeed it has been observed, that the very uppermost pods never contain so good seeds as those which grow lower. When the seeds begin to ripen, great care must be taken that the birds do not destroy them, for they are extremely fond of this food. To prevent their depredations, some throw nets over their seeds: but this will not always do; for unless they are very strong, the feathered tribe will force their way through them, as Mr. Miller says he has often seen, when old nets have been used for this purpose. He therefore prefers bird-lime, dawbed over a parcel of slender twigs fastened at each end to stronger sticks, placed in various positions near the upper parts of the seed branches, so that the birds may alight upon them, and be fastened thereto: adding, that he has experienced, that when two or three birds are thus caught, and let remain there a considerable time, if they cannot extricate themselves; this will so terrify the rest, that they will not come to that place again, for a long while.

When the seeds are fully ripe, they must be cut off, dried, threshed out of their pods, and laid up in bags for use.

The

The *Napus sylvestris*, or wild navew, commonly known by the name of rape, or cole, is much cultivated in the isle of Ely, and in some other parts of England, for it's seed, from which the rape oil is drawn; and it hath also been very advantageously cultivated, of late years, in other places, for feeding of cattle. When it is intended for this purpose, it should be sown about the middle of June, on ground prepared as for turneps, that is to say, in very fine tilth. The quantity of seeds for an acre of land is from six to eight pounds: but as they are not dear, it may be best to allow eight pounds, because it will be easy to thin the plants wherever they are too close, when the ground is hoed. This should be done as soon as they have put out about half a dozen leaves, in the same manner as is practised for turneps, with the difference only of leaving these plants much nearer together: for as they have fibrous roots, and slender stalks, they do not require near so much room. A second hoeing, well performed, in dry weather, about five or six weeks after the first, will be all the culture that these plants will want. They will be large enough for feeding by the middle of November, when, if there be a scarcity of other fodder, this may be cut: but if there is not an immediate want of food, it had better be kept as a reserve for hard weather, or spring feed, when there may be a scarcity of other green food. If the heads of these plants are cut off, they will shoot again early in the spring, and produce a good second crop in April, which may be either used for cattle, or let run to seed, as is the practice where this plant is cultivated for it's seeds. It is so hardy as not to be destroyed by frost, and therefore is of great service in hard winters, for feeding of ewes: for when the ground is so hard frozen that turneps cannot be taken up,

O 2

these

these plants may be cut for a constant supply, Mr. Miller says he has found, in several places where he has sowed this seed, that one acre of land thus planted will produce almost as much food as two acres of turneps; that this will afford late food after the turneps are run to seed; and that, if it is permitted to stand for seed, one acre will produce as much as, at a moderate computation, will sell for five pounds, clear of charges ^b.

Partridges, pheasants, turkeys, and most other fowls, are so fond of these plants, that, if there be any of them in the neighbourhood of the field where they are cultivated, they will flock thither, and lie constantly among them^c.

Experiments on Cabbages cultivated according to the New Husbandry.

M. De Chateauvieux, intent upon trying whether all kinds of pot herbs may not be raised by the new husbandry, cheaper, more easily, and even better, without dung, than they are in the common way with a great deal of that manure; extended, in the following manner, the experiments of which a part has been already given*.

On the 25th of September, 1751, having singled out a spot of ground which had not been dunged at all for several years, but which had been thoroughly plowed the year before, when one half of it bore barley, and the other oats; he plowed in it, exactly as if it had been intended for wheat, a bed 160 feet long, and six feet seven inches wide, and planted on it a single row of white cabbages, which were then watered, to make them

^b *Gardener's Dict. ART. BRASSICA..* ^c *Ibid.*

^d *Ibid.* on carrots, p. 175; on beet roots, p. 176; and on skirrets, p. 178.

take root the better. The middle of this bed, which was it's highest part, was exactly over the intermediate furrow of the preceding year.

That he might be the better able to make a just comparison between the cabbages of this bed, and those of his kitchen-garden, he planted a spot of ground in this last place, the same day, with the same sort of plants. This spot had been extremely well dug, and plentifully dunged by his gardener, who took all possible care of these plants, and weeded and watered them as often as was necessary; but instead of cabbaging, most of them ran up in height: upon which they were plucked up, and others were planted in their stead.

The row of cabbages in the undunged bed had just the same culture as would have been given to wheat.

On the 9th of March, 1752, the first stirring of the ground was performed with the plough. On the 25th of April, the second stirring was given with the cultivator. On the 3d of June, the third stirring was performed with the plough: and lastly, on the 20th of July, the plants were hoed by hand, for fear of hurting several stalks of wheat which grew on the next adjacent bed, and which were bent, but not lodged, so as to incline over the furrow of separation.

The cabbages were never watered after the time of planting them, and then only once: and yet they were always crisp and firm, even in the hottest days. By this easy and expeditious culture, they obtained all the perfection that could be wished, and surpassed those of the kitchen garden, as much in goodness, as they did in size. Most of them weighed between 15 and 18 pounds, and

the smaller between 8 and 10. The whole crop of this bed weighed upwards of 840 pounds.

In 1753, M. de Chateauvieux repeated his experiments on the same plants, *viz.* carrots, beet roots, skirrets, and cabbages; and all of them were as fine, and well flavoured, as before.

The same culture of the same plants answered equally well in the years 1754, 1755, and 1756. They were, in every respect, much finer than those of the kitchen garden; and, which is a very important proof of the excellency of the new husbandry, in that it constantly preserves a due degree of moisture in the earth; nothing could be more striking, than, in 1754, and 1755, which were very hot and dry years, to see these plants, always green, and in great vigour, thrive without any alteration; while those in the kitchen garden, which were watered every day, drooped during part of the day, and grew but very slowly.

Another of M. Duhamel's correspondents writes to this effect: "My pot-herbs in beds (cultivated with the horse-hoe) are the admiration of all who see them. I have cabbages which, I dare say, will weigh upwards of 45 pounds a-piece. I had some last year, which weighed 35 pounds; and the ground was not so well cultivated then, as it is now, nor were they so early. They have not suffered at all from the drought; but, on the contrary, the warmer the weather has been, the finer they have grown. They have not been watered at all; nor have my carrots; and I have cabbage lettuces which weigh five pounds. One great advantage which I find in the new husbandry, is that the plants are preserved from the danger of too much rain, or too much drought. The earth, when well cultivated, is

“always in a moist state. The more I reflect on
“this new method of culture, the more I admire
“it. None but those who are thorough judges
“of agriculture, can foresee the immense advantages which will hereafter attend it.”

At the rate of 840 pounds of cabbages on a bed 160 feet long and 6 feet wide, an acre will yield nearly 35,280 pounds. If we estimate their weight only 35 pounds each, as in the foregoing experiment, instead of 15 or 18 pounds according to M. de Chateauvieux's, the produce of an acre will then be at least doubled. Or if we suppose that cabbages can be raised in great perfection in beds four feet wide, the produce of an acre, on the footing of M. de Chateauvieux's estimate, will be 55,000 pounds. I do not know that it has yet been ascertained by experiment, how much cabbage a bullock can eat in a day: but, that I may be sure to allow him enough, I will suppose it to be half as much again as he can eat of turneps, that is to say 300 pounds of cabbages, which are a less substantial food. Now even at this allowance, in which the animal is surely not stinted, the above produce of an acre of land; supposing it to be but 35,280 pounds of cabbages, will feed a bullock during four months.

The cakes of the rape or cole seed are great fatteners of cattle, and so are the cakes of lin-seed, after their oil has been extracted: but they are apt to render their fat yellow and rank. To remedy this, they should be fed with dry fodder, for a fortnight or three weeks before they are killed.

I have already mentioned these cakes as an excellent manure for land: but I believe they will turn to greater profit when used for the food of cattle.

ARTICLE II.

OF CLOVER.

THERE are many species of this plant; but the sorts generally cultivated in the field, for the food of cattle, are, the red or Dutch clover (*Trifolium purpureum majus, pratense simile*, Ray. Syn. 328); the white meadow trefoil honey suckle grass, or white Dutch clover (*Trifolium pratense album*, C. B. P. 327); and the yellow meadow trefoil, or hop clover (*Trifolium pratense luteum, capitulo lupuli, vel agrarium*, C. B. P.

The red clover, too well known to need any particular description*, is a biennial plant, whose roots decay after they have produced seeds: but if the plants are eaten down, or mowed, when they begin to flower, they will sprout out anew, and by that means continue longer than they would otherwise. The usual allowance of seed

* To distinguish it from the red meadow trefoil, with which Botanists have frequently confounded it, on a supposition of their being the same species, Mr. Miller observes, that he has often sowed the seeds of both in the same bed, and that they have constantly produced their respective species, without varying. The stalks of the meadow trefoil are weak and hairy, the stipulæ which embrace the footstalks of the leaves are narrow and very hairy; the heads of the flowers are rounder than, and not so hairy as, those of the clover, whose stalks are strong, almost smooth, furrowed, and rise twice the height of the other. The heads of the flowers of the meadow trefoil are larger, more oval, and more hairy, than those of clover; their petals open much wider, and their tubes are shorter. But the clover has been so much cultivated in England for near a hundred years past, that its seeds have been scattered over most of our pastures, so that there are few of them which have not clover mixed with the other grasses; and this has often deceived botanists, who have supposed that the meadow trefoil has been improved to this, by dressing of the land. *Gardener's Dict. Art. TRIFOLIUM,*

for

for an acre of ground, in the common husbandry, is ten pounds. In the choice of the seed, that which is of a bright yellow colour, inclining to brown, should be preferred; and the pale coloured thin seed should be rejected.

The general custom in England is, to sow this clover with barley, in the spring: and when the barley is taken off the ground, the clover spreads and covers it, and remains two years: after which the land is plowed again for corn, and is thought to be greatly enriched by the clover. The clover seed should not be sowed, till after the barley has been harrowed in; for otherwise it would be buried too deep: and after it is sown, the ground should be rolled to press the seeds into it: but this should be done in dry weather, because moisture will often make the seeds burst, and when the ground is wet, they will stick to the roller, and the surface of the soil will be so hardened by the rolling, that numbers of plants will fail, for want of being able to pierce through it. This is the general method, when clover is sowed with corn. But it would be much better always to sow it alone; for then the plants come on much faster, and are not choaked, for one whole season, as they frequently are in the other way, when the crop of corn is great.

Mr. Miller, after many years trial, advises therefore to sow the seeds of clover in August, when there is a prospect of rain soon after: because the ground being then warm, the first shower of rain will bring up the plants, and they will have time enough to get strength before the winter; and a good rolling in October, when the ground is dry, will press it close to the roots, and make the plants send out more shoots: and this he advises repeating again in March. The reason of his preferring this season for sowing clover, rather than the spring, is, because the ground is cold and wet in the
spring

spring, and if much rain fall after the seeds are sown, they will rot in the ground; and many times when the seed is sowed late in the spring, if the season should prove dry, the seeds will not grow.

The author of the new System of Agriculture, too apt sometimes to be positive in his opinion, agrees with Mr. Miller, that it is best to sow clover in the autumn, and always by itself, on land brought to the finest tilth possible, and cleared of all fibrous roots and other trash, by going over it with fine toothed harrows: but he differs from him in regard to the quantity; the former strongly recommending, never to sow less than twenty pounds upon an acre.

“Many, says he^f, will object against this, because they never knew any man sow above half that quantity.—I answer, they never knew any man who reaped half the profit which he might have done by it, if he had followed my directions.—It is observable, that there are more ignorant men who profess husbandry, than of any other art; and yet fewer of this profession, than any of the rest, who think they can be taught. A man, not possessed of this temper, would easily imagine that the thicker this little seed is sown, the thicker it will spring, and the better keep down all weeds, and common grass, and, consequently, become of double advantage*.

“Sowing

^f Page 208.

* The smallness of a seed is certainly no rule to judge of the size of the plant, or of the space most proper to be allowed for it to grow in. Nor can it be supposed, but that clover, as well as any other plant, may be sown so thick that the whole crop will be thereby choaked, and hindered from growing; or at least, from growing to the perfection it would otherwise attain. The very circumstance of the smallness of the seed is essentially

“ Sowing clover in September, instead of the
 “ spring, and sowing it alone, has many conveni-
 “ encies: it will rise thick, and swarth the ground,
 “ before the hard weather comes in; and thereby
 “ not only gather strength, to defend itself against
 “ the winter frosts; but will be so early in the
 “ spring, that you might mow it, the first time,
 “ in the very beginning of May, or, perhaps,
 “ sooner.

“ When the first hard frosts have bound the
 “ earth so fast that you may bring horses upon it,
 “ without damage to the roots of the clover, this
 “ is the very point of time in which you should
 “ bestow about eight or ten load of sea-ouze, sea-
 “ sand, sheep’s dung, or that of the sterconary,
 “ upon every acre, taking care to spread it as
 “ equally as may be, that, when the frost dissolves,
 “ the rains may drive the strength of the manure
 “ into the earth, which, in the tender infancy of
 “ the new turf, will easily admit it, to the nourish-
 “ ment of the roots, and surprising increase of
 “ your clover, both as to quantity and sweet-
 “ ness.”

Upon this difference of opinion with regard to the quantity of clover-seed most proper to be sown, Mr. Maxwell, who likewise is not infallible, reasons thus:

“ In an acre of land there are 160 square perches of 16½ feet to the perch; and in five pounds of clover seed, there are 160 half ounces; which is half an ounce to the perch. In half an ounce of clover seed, if well chosen, there will be found

§ Miscellaneous Papers on Husbandry, p. 46.

essentially to be considered in this, as in all other small grains, in order to guard against the general, and fatal, error of sowing too thick: for, as I have repeatedly observed, it is not the size or quantity of the seed, that is to be considered in sowing; but the bulk and nature of the plant.

to be (after a trial made by water) about 8000 good seeds, which, if regularly sown, may produce at least 7000 good plants: whereas one square perch cannot contain above 1156 plants at six inches equal distance. I think I am able to maintain, that plants of clover are sufficiently near each other at six inches distance, considering how many stems each root sends forth when standing at due distances. I would now ask, what comes of all the plants that arise from twenty pounds sown on an acre. The answer appears plain. They rob and starve one another, and are of very little value in comparison of what they would be if there was more space of ground betwixt them: just as it happens when a sower loses by accident some handfuls of corn, which falling thicker than reasonable, the produce is of small value, both with respect to ears and straw, when all that is sown at a due distance makes a valuable crop in both respects. This is confirmed by experience: for I have cut clover sown with twenty pounds to the acre, and with five pounds to the acre. That sown with five pounds produced the strongest and best crop, though the ground on which both grew was in equal good heart, the same soil, and prepared in the same manner. A worthy member of our (the Edingburgh) Society has made the experiment, and will bear witness that it answered to satisfaction.

“In support of my opinion, I incline to mention an experiment of Mr. Tull’s in a similar case, in his own words. “I saw, says he, the produce of two sainfoin plants carefully weighed. They both grew on the same ground, not far asunder, and were of the same age, viz. seven years. The one stood single, and it’s pro-

Ibid. p. 48.

duce

"duce weighed thirty seven ounces and a half.
 "The other grew in a bunch among many neighbours, and was dug up; and its produce, cut close to the root, weighed three grains; which is about a five thousandth part of the other. I think this proves that it is not extravagant to say, one single, or thin, Sainfoin plant may produce as much grass or hay, as a thousand thick ones: but I have seen much greater sainfoin plants than this."

"As clover seeds are liable to be scorched and killed, if sown in very hot weather, for their smallness is such that they should be but barely covered; I would, to prevent this as much as possible, advise steeping them before they are sown, and drying them with chalk finely powdered, which will also conduce to their being sown the more equally, as their whiteness then will render them the more discernable."

Experience shews, that very shallow sowing of clover seed is necessary in this country. But the reverend Dr. Elliot, in whom mankind has lately lost an universally beneficent friend, and America now laments the death of her doctor Hales, found, likewise by experience, that it grows best in the province of Connecticut, of which he was a shining ornament, when it has been sown at full furrow depth, and that shallow sowing of it there is attended with a certain loss, if a dry season comes on soon after; whereas this danger is prevented by sowing deepⁿ. The very great heat in that inland part of the continent, may, in some measure, account for this wide deviation from what is known to be the right practice here.

About the middle of May, this grass will be fit to cut; when particular care should be taken in

making it into hay; for it will require a great deal more labour, and time, to dry, than common grass, and will shrink into less compass: but if it be not too rank, it will make excellent food for cattle. The time for cutting it is when it begins to flower; for if it stands much longer, the lower part of the stems, and the under leaves, will turn yellow, and these last will fall off, and consequently the quantity of the hay will then be less, and not so well flavoured. Care should likewise be taken not to stack it till it be thoroughly dry, for fear of it's heating.

One acre of this plant will feed as many cattle as four or five acres of common grass: but they must not be suffered to eat too plentifully of it at first, lest it burst them. It should be given them by degrees, till they are fully seasoned to it: nor should they ever be turned into this food in wet weather. Some sow rye grass among their clover, and let them grow together, in order to prevent the ill consequences of the cattle feeding only on clover: but in this they are to blame; because the rye grass does great injury to the clover; for, rising earlier in the spring, it covers and cripples the young clover; and besides, it is observed to exhaust the land, as well as to bind the surface of it by it's numerous creeping horizontal roots. However, it is yet a question with farmers, whether the additional weight of grass which the rye grass yields, does not counterbalance these disadvantages.

This plant is reckoned much better fodder for most other cattle, than for milch cows; wherefore these should seldom have any of it; though when it is dry, it is not near so hurtful to any sort of cattle, as when green.

When the seeds of clover are designed to be sowed, the first crop in the spring should be let stand

stand till they are ripe, which is known by the stalks and heads changing to a brown colour: and then it should be cut in fair weather, and be well dried before it is laid up; for otherwise the seeds will not easily quit their husks, when it is threshed. To this is owing a common complaint of farmers, that they often times cannot thresh out their clover seed without great labour and difficulty. But it will generally be found in this case, that these are second crops, which ripen late in autumn, when there is not heat enough to dry the husks sufficiently to make them part easily from the seed.

To remedy this inconvenience, the justly regretted Dr. Eliot proposes the following, as the most effectual and expeditious way of cleansing this seed.

“ Take, says he, your clover hay to a tanner’s bark-mill, where they use a stone wheel, grind it, and clear it from the chaff with a corn-fan: what heads or chaff are not fully cleared, and all the seed got out, put upon the floor and grind again, and fan it as before. In this manner, I am told, a man will quite clean a bushel in one day; nor will the stone wheel crush and spoil any of the seed; a mischief which, at first, one would think unavoidable. Where a stone wheel cannot be had, it may be worth while to try a cyder-mill: but I fear there will want the roughness of the stone to tear off the chaff.”

Mr. Maxwell thinksⁱ that clover is benefited by being sown with barley or oats, because, being weak and tender the first year, it would be overcome by weeds, which would grow in great numbers, if not kept down by a crop of corn, the stems of which, being at a sufficient distance to admit the

^h *Essays on Field Husbandry*, p. 30.
Papers on Husbandry, p. 18.

ⁱ *Miscellaneous*

air to the clover, will at the same time also protect it from drought. The stubble proves a farther protection, after the corn is cut down, and when it rots, it manures the ground.

But he is against sowing rye-grass with it; because gramineous plants are impoverishers of land, while the leguminous enrich it: as a proof of which he instances a field which was sown with rye-grass and clover, but in sowing the rye-grass, one ridge happened to be missed. This ridge, after the first year, had much finer clover, and when the ground was plowed up, it bore far better corn than the rest of the field.

Mr. Tull, on the contrary, disapproves of sowing clover, but particularly the broad leaved sort, with barley, of which, he says*, he has known a crop be damaged by it, in a wet summer, to the value of four pounds an acre. However, he observes that this may be prevented, by drilling the clover after the barley is a hand high, or more: for then the barley will keep it under, and not suffer it to grow to any considerable size till after harvest; nor will the drill hurt the barley, if it be drawn by hand.

“ In a dry summer, continues Mr. Tull, extolling the superior worth of sainfoin, both the broad leaved and the hop clover are apt to miss growing; and if the broad leaved does grow, and the next summer (when it ought to be a crop) prove very dry, it fails on most sorts of land, though it was vigorous enough to spoil the barley the year it was sown. At best it is of but very short duration, and therefore is not to be depended on by the farmer, for maintaining his cattle, which the broad clover will also kill, sometimes by causing them to swell, unless

* *Horse-hoeing Husbandry*, p. 188.

“ great

“ great care be taken to prevent their eating too
“ much of it whilst it is green. The broad clover
“ is esteemed a foul feed for horses, and the hop
“ clover is gone out of the ground sooner than
“ the broad clover: I never knew it cut more than
“ once. Indeed cattle are never swollen by feed-
“ ing on it; but then it affords but very little
“ feeding for them, except the land whereon it
“ grows be very rich.”

No consideration whatever should induce the farmer to let his clover stand more than two years. He should then, at the very latest, plow it up. But I would recommend, as a much better practice, and that which is followed by the best husbandmen; to take only one crop, of the first year, and to plow down the second crop, to prepare the land for wheat.

When the clover grows very luxuriantly, some are tempted to continue it another year; and in that case they frequently let the second crop run to seed; or at least such part of it as may be sufficient to answer the exigencies of the farm. But, in this case, as all plants which run to seed impoverish the ground greatly; the land on which the clover has seeded should be laid up rough during the winter, to prepare it for a spring crop. Barley and oats are the only crops with which it should be sown: but barley is the best.

If clover has stood three years, a rich crop of wheat cannot possibly be had next after it, without losing a crop of some other grain, by a summer fallow; because the ground, though in the very finest tilth when the barley was sown, for such it ought to be both for that grain and for this plant, will by that time be grown hard and stiff, and bound with the roots of grass and weeds, which will have prevailed as the clover died away. To

prevent this inconvenience, the clover should, as before advised, be plowed up after one crop.

Mr. Lisle, after observing that broad clover runs sooner to grass when fed, than when mowed, and that the first year's clover makes the best early grass for horses*; instances, however, from his own experience, the advantage of the second year's growth of broad clover, for feeding cattle in the spring. He tells usⁿ, that in the year 1719, his great cattle must have starved, had it not been for this relief, which supported them from the middle of April to the middle of May, nearly as well as the first crop of the same plant had done, the former year, in July and August: for that his fodder-straw being gone by the middle of April, and no rain having fallen for five weeks before, so that there was no grass of any other kind, the after-growth of twenty acres of this clover maintained, during the above time, twenty-three yearlings, and eight steers of four years growth, besides a great many hogs, and yet the pasture grew, and run more and more to a head every day, though sheep had fed it down bare early in the spring, and the ground was not shut up till the beginning of April, when a north-east wind, which had blown for a long time, and the drought, still continued to oppose the growth of all grass.

It cannot be doubted, that all sorts of clover would grow much larger and stronger if sown in drills and hoed between the rows, than it does in the common broad-cast way; though it is a question with M. Duhamel^o, whether it be not too short lived, properly to admit of this method. In

* The second crop of all grasses is less valuable than the first.

ⁿ *Observations in Husbandry*, Vol. II. p. 44.

^o *Eléments d'Agriculture*, Tom. II, Liv. 9. c. 2.

his treatise on the culture of land, he gives us the following experiment on this plant^p.

M. de Pontbriant, of Rennes in Britany, sowed about half an acre of land with flax and hemp, mixed with clover seed. As soon as the former were plucked up, the clover appeared, and grew so well that it was cut in November of the same year. It was weeded in February, and mowed again in the beginning of May. As it was too thick, he made alleys in it a foot wide. These alleys furnished him with plants enough to stock upwards of an acre and an half of other land, where they were set a foot and a half asunder, which is a sufficient space for hoeing, and they thrive admirably well.

The French have their clover seed from Flanders, Italy, and their own province of Burgundy.

To guard against the insect (be it fly or worm) which sometimes eats the clover seed in the ground, the author of the new System of Agriculture advises^q steeping it, for the space of a night, in foot, and as much urine, as will make it liquid. How far this may really answer, I know not; but he seems to recommend it very confidently.

The white clover, generally known among farmers by the name of white honey suckle, is a lasting plant, and therefore belongs properly to the subject of permanent pastures, under which it will accordingly be treated of; as will also the several sorts of meadow trefoil.

^p Tom. III. p. 419.

^q p. 208.

C H A P II.

Of perennial Plants used for the food of Cattle, and which require frequent help while they grow.

HAVING restricted myself, in the preceding chapter, to the culture of such vegetables as are, or may be, sown interchangeably with crops of corn, for the food of cattle; I am now to speak of those other plants used for pasture, which, though perennial, require more care and attention than is commonly bestowed on grasses. Of these Sainfoin and Lucerne are the chief: and, if we may judge by the success he has hitherto met with, the world will be greatly indebted to Mr. Rocque of Walham Green, for his particular culture of Burnet, which being a native of this country, and remarkably hardy, promises considerable advantages.

A R T I C L E I.

OF SANFOIN.

THE French call this plant *Sanfoin*; *sain*, in their language, signifying wholesome, and *foin* hay; because it is observed to agree extremely well with all sorts of cattle. Our writers on husbandry are apt, improperly, to call it *saint foy*, and frequently *French grass*; because we owe our first knowledge of it to the French. It's Latin name is *Onobrychis*.

If Sainfoin is cultivated according to the new husbandry, it's stalks will grow five feet long; and, according to Mr. Tull^a, one acre of it will

^a *Horse-hoeing Husbandry*, c. 12.

yield as much grass as 30 or 40 acres of common pasture.

This great fruitfulness of sainfoin is owing to the vast quantity of it's roots. It's tap-root pierces sometimes fifteen or twenty feet deep into the earth, and sends forth many lateral branches, which extend a great way, especially towards the surface of a good soil.

It is wrong to think, as many do, that sainfoin will not succeed if there is not, at a certain depth, a bed of gravel, stone, or chalk, to stop the progress of it's roots. On the contrary, the deeper the earth is, the more it's roots extend, and the stronger and more flourishing is the plant.

As some of it's seed will frequently not grow, a small quantity should always be sown first, to try it, as has been directed in regard to wheat, and other plants.

Sainfoin ought not to be sown above half an inch deep, especially in stiff lands: for the heads of it's seeds are so large, and their necks so weak, that if they lie much more than half an inch deep, they are not able to rise through the incumbent mould.

As this plant yields but an inconsiderable produce the first year, the farmer, in order to make the more of his land, often sows barley, oats, clover, &c. with it. The barley and oats remaining but a short time on the earth, do no great injury to the sainfoin: but clover, and other perennial plants, hurt it very much.

It frequently happens, in dry years, that no sainfoin is seen when the barley or oats are mowed: but on examining nearly, we may generally perceive white threads, which shew that the sainfoin has sprouted, and that it's leaves, then very small, have been cut off by the scythe.

If the other feeds sown with the sainfoin, come up thick, and grow a-pace, and especially if they are lodged, the sainfoin is generally choaked. But this seldom happens if it is sown with the drill-plough: for as it is then planted by itself, in separate rows, it is less in danger of being overpowered by any other plants. It certainly does best when sown quite alone.

When Mr. Tull began to cultivate sainfoin with the horse-hoe, he sowed two gallons of seed to an acre, and almost all the seed of an acre or two of ground perished, through it's being sown too late. But he was agreeably surprized at the end of three years, to see some plants of this herb, of an extraordinary size, dispersed here and there, in such manner that there were about four plants in a yard square. This part of his field yielded him double the quantity of grass than the rest of it did, where the seed had not perished, and where the sainfoin was much better than in lands which had been sown in the common way.

He concludes from thence, that it is most profitable to sow sainfoin thin, that the roots of one plant may not hurt those of another: and he thinks that they deceive themselves who sow their sainfoin very thick in hopes of reaping a more plentiful crop; because, by so doing, they reduce their sainfoin to the condition it is in on the hills of Calabria, near Croto, where it grows naturally, without any culture, but so low and stunted, that one would almost wonder what could induce any one to think of cultivating so unpromising a plant as it there seems to be.

Mr. Tull supports his opinion by an observation which it may not be improper to mention. He says, that a field of sainfoin adjoining to a piece of land which he had ordered to be plowed up for corn, was greatly damaged by the plough, which

which, breaking in upon the sainfoin, tore up several plants: but that this part of the field yielded afterwards more grass than the other.

He thinks a gallon of good seed enough for an acre of land. But this seed should be so distributed, that all the plants may be at equal distances; which cannot be done but with the drill-plough. There is no fear of diminishing the crop, by lessening the number of the plants; for one plant well cultivated will yield above half a pound of hay; and consequently, if only 112 plants grow upon a square perch, and yield one with another only a quarter of a pound each, they will produce after the rate of two tons to an acre. One would not expect so considerable a return while the plants are yet small and young, before they cover the ground, and while the field looks as if the greatest part of it lay waste: but when they have attained their full growth, they cover the whole surface. Another advantage arising from the new husbandry is, that if the sainfoin has been sown early, it yields a crop the second year, in this way, equal to the third year's crop of that which is sown according to the common method.

Mr. Tull^b draws these conclusions from his experiments.

1. When sainfoin is sown with a design to cultivate it with the horse-hoe, the best way is to sow it in two parallel rows, eight inches distant from each other, and to make the alleys forty inches wide; so that from the middle of one furrow, to the middle of another, shall be four feet.

2. If sainfoin is sown with an intention only to hand-hoe it, the space between the rows should be sixteen inches, and the plants in the rows should be at least eight inches asunder.

^b *Ubi supra.*

3. When sainfoin is sown without any design to hoe it, the best way is to drill the rows eight inches asunder, with no greater quantity of seed than when they are at sixteen inches distance: for each plant ought to have a sufficient space around it, to extend it's roots in, and draw it's necessary nourishment from, without hurting it's neighbouring plants.

Sainfoin thrives best in a rich, dry, and light soil, especially if there is a bed of lime, chalk, or gravel, under a considerable depth of mould. In marshy grounds, or in lands which retain water, the roots are chilled, and the plant soon perishes. Though it is a strong plant, the ground on which it is sowed, ought to be in very fine tilth: for as it shoots out a great number of roots the moment it sprouts, the mould ought to be loose, and the staple as deep as possible. It may be sown at any time: but if so late as autumn, the young plants will be in danger of being hurt by frost: and if it is sown in summer, the seed frequently remains long in the earth without sprouting; or if it rises, the drought, usual at that season, stints the young plants. The spring is therefore the most proper season for sowing it, when there is no longer any danger of hard frosts.

By means of the drill-plough, the seed of the sainfoin is dropt into channels which this instrument makes, and is at the same time covered with the proper depth of earth.

It will not be necessary to horse-hoe the alleys between the beds of sainfoin, so often as between those of corn. Once a year will be sufficient for the alternate alleys: so that one half of them will be rested yearly, and the hay may be made thereon. By this means the expence will be but trifling, and the sainfoin may last thirty years on the same ground, which, by this frequent stirring, will

will be the better prepared afterwards to receive grain.

Sainfoin deserves the farmer's utmost attention, as one of the most profitable plants he can cultivate. It will do on almost any land; and though it succeeds best in good soils, yet it will grow even on dry barren spots, where scarce any other grass can live; provided it's roots be not chilled by a cold clay, or other substance which retains water: and it has this farther advantage, that it may be mowed at different degrees of ripeness, with nearly the same profit.

1. It may be mowed before it is in bloom, for it is then admirable food for horned cattle; and when cut thus early, it yields a second crop, which makes ample amends for what was lost by not letting the first come to it's full growth. This early cutting is likewise attended with another benefit, which is, that it purges cattle, in the beginning of the summer, and thereby frees them from disorders occasioned by the winter's cold, or dry food.

2. If the weather be rainy, the sainfoin may be left standing till it is in bloom; when it still is excellent fodder for cows. But care must be taken in making it into hay, that the flowers do not drop off, as they are very apt to do: for cattle are so fond of these flowers, that they often induce them to eat the rest of the plant.

3. If the rain continues, the sainfoin may be left standing till some of it's seeds are formed, and the crop will then be the more plentiful; not only because it will have attained it's full growth, but likewise because it's leaves, being more substantial, diminish less in drying. It is not indeed, then, quite so sweet as before; but horses eat it

* DUHAMEL, *Culture des Terres*, Tom. I. c. 19. p. 152.

readily,

readily, because they love to feel between their teeth the seeds which now begin to be formed.

Mr. Tull says, this fodder is so excellent, that horses need no oats when they are fed with it. He affirms, that he kept a team of horses with it a whole year in good plight, without giving them any oats, though they were worked hard all the time. He adds, that he fattened sheep with it, in less time than others which were fed with corn. But the hay of this plant can never be so good as when it is cultivated with the horse-hoe: for in the common husbandry, it blossoms almost as soon as it is out of the ground.

4. If the season continues rainy, it may be more adviseable to let the sainfoin remain standing, than to run the hazard of having it rot upon the ground: for then the seed will ripen, and nearly make up for the loss of the fodder; not only because it will fetch a good price, but also because two bushels of it will go as far in feeding of horses, as three bushels of oats; and cattle in general, as well as poultry, are extremely fond of it*.

Even the sainfoin that has yielded it's seed, may be cut down and dried; and when other fodder is scarce, this will be better food for horses and large cattle, than the coarse hay of flowered meadows, or any kind of straw.

* The first of these sorts of sainfoin hay, cut before the bloom, is Mr. Tull's *virgin* hay, which, he says^t, is the best beyond comparison, and has not it's equal in the world, except lucerne. He gives the next place to the second sort, cut whilst in bloom, and says that an acre of land, well cultivated, may yield three tons of this *blossomed* hay: and he esteems the third sort, which he calls *full grown*, many degrees inferior to either of the former; though it yields a greater crop, because it has grown to its full bulk, and shrinks but little in drying.

^t *Horse-hoeing Husbandry*, c. 12.

The manner of making sainfoin hay is thus directed by M. Duhamel s.

In a day or two after the sainfoin has been mowed, it will be dry on the upper side, if the weather be good. The swarths, or mowed rows, should then be turned, not singly, but two and two together: for by thus turning them in pairs, double the space of ground is left betwixt pair and pair, and this needs but once raking; whereas, if the swarths were turned singly, that is, all the same way, the ground would require as much raking again.

As soon as both sides of the swarths are a little dry, they should be made up into small cocks, the same day they are turned, if possible: for when the sainfoin is in cock, a less part of it will be exposed to the injuries of the night, than when it lies scattered upon the field. The sun and dew would exhaust almost all it's juices, in this last case, in less than a week's time.

These little cocks of sainfoin may be safely made into larger ones, without waiting for their being so thoroughly dry as those of common hay ought to be before they are laid together: because common hay, by sinking down closer, excludes the air necessary for keeping it sweet; so that if the weather prevents it's being frequently stirred and opened, it will heat, turn yellow, and be spoiled; whereas sainfoin, by admitting the air more freely, because it's stalks are less flexible, will remain much longer without any danger of fermenting.

Sainfoin hay is never better than when it has been dried by the wind only, without the assistance of the sun. A little rain or a mist, which will turn common hay, clover, and even lucerne, black;

• *Ubi supra*, p. 253.

will do no hurt to sainfoin, which is not really spoiled, till it rots upon the field.

If the weather threatens rain, and the sainfoin is not yet dry, it may be laid in cocks, without fear of it's heating, provided a large basket, or bushy faggot, be set up in the middle of each cock, where it will serve for a vent hole, through which the superfluous moisture of the hay will transpire.

As soon as all danger of it's heating is over, these cocks should be made into ricks, and thatched. That which is laid up quite dry, will come out of the rick of a green colour: that which has heated much in the rick, will look brown.

It requires some experience to know at what degree of ripeness it is best to cut the seeded sainfoin; because all its seeds do not ripen at the same time. Some ears blossom before others; every ear begins blossoming at it's lower part, and continues to blow gradually upward, for many days; so that before the flower is gone off at the top, the seeds are almost filled at the bottom. By this means, if the cutting be deferred till the top seeds are quite ripe, the lower, which are the best, would shed, and be lost. The best time, therefore, to cut it is, when the greatest part of the seed is well filled, the first blown ripe, and the last blown beginning to be full. The unripe seeds will ripen after cutting, and be, in all respects, as good as those that were ripe before. Some, for want of observing this, have suffered their sainfoin seed to stand till all of it has shed, and been lost in cutting.

Sainfoin should never be cut in the heat of the day, while the sun shines out: for then much, even of the unripe seed, will shed in mowing. The right time for this work, is the morning or the evening,

evening, when the dew has rendered the plants supple.

If the weather is fine and clear, the sainfoin will soon dry sufficiently in the swarths, without turning them: but if any rain has fallen, and there is a necessity for turning them, it should be done very gently, while they are moist, and not two swarths together, as in the other hay made of sainfoin before it has seeded. If the swarths are turned with the handle of the rake, it is best to raise up the ear-sides first, and let the stub-side rest on the ground in turning: but if it is done with the teeth of the rake, let the stub-side be lifted up, and the ears rested on the earth.

If sainfoin be cocked at all*, the sooner it is done, the better; because, if the swarths are dry, much of the seed will be lost in separating them; the ears being entangled together. When moist, the seed sticks fast in the ear; but when dry, it drops out with the least touch or shaking.*

There are two ways of threshing it: the one in the field, the other in the barn. The first cannot be done but in very fine weather, and while the sun shines in the middle of the day. The best manner of performing this, is to have a large sheet pegged down to the ground, for two men to thresh on with their flails, while two others bring them fresh supplies in a smaller sheet, and two more clear away the hay that has been threshed. The seed is emptied out of the large sheet, and riddled through a large sieve, to separate it from the chaff and broken stalks; after which it is put into sacks and carried into the barn to be winnowed. Care

* Sometimes it is threshed in the field, without being cocked; and in this case, the swarths are only just separated, in the dew of the morning, into parcels of about two feet each; by which means it is sooner dried than when it lies thicker, as it must do, if made into cocks.

should

should be taken not to let the hay get wet, because it would then be spoiled.

A very important, and at the same time very difficult article, is the keeping of the seed that has been threshed in the field, without having ever been wetted. If it be winnowed immediately, and only a little of it laid amidst a great heap, or put into a sack, it will ferment to such a degree, in a few days, that the greatest part of it will lose its vegetative quality. During that fermentation, it will be very hot, and smell sour. Spreading it upon a barn floor, though but seven or eight inches thick, will answer no end, unless it be frequently and regularly turned both day and night, until the heating is over: but even this will not make its colour keep so bright as that which is well housed, well dried, and threshed in the winter. This last, laid up unthreshed, will keep without any danger of spoiling, because it does not lie close enough to heat. The best way to preserve the seed threshed in the field, is, to lay a layer of straw upon a barn floor, and upon that a thin layer of seed, then another layer of straw, and another layer of seed, and so on, alternately. By this means, the seed, mixing with the straw, will be kept cool, and come out in the spring with as green a colour as when it was put in: or it may be preserved in one of M. Duhamel's ventilating granaries.

The greatest part of the sainfoin that is sown, is spoiled by being indiscreetly fed by cattle. Mr. Tull is against feeding it at all during the first and second year, or in the spring of any other year. He says he has recovered worn-out pieces of sainfoin, by plowing them in alleys three feet wide, and leaving beds of sainfoin of the same breadth alternately between them. The plants, by extending their roots in these new plowed alleys, have recovered their vigour, and yielded good crops of hay.

And

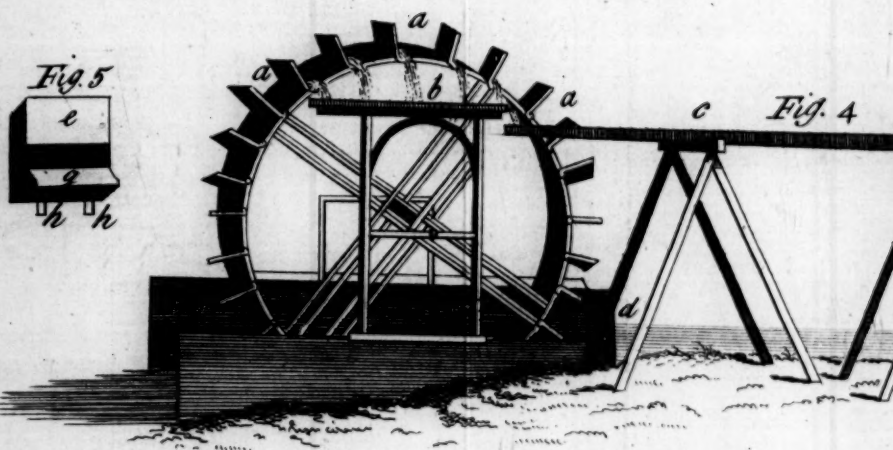
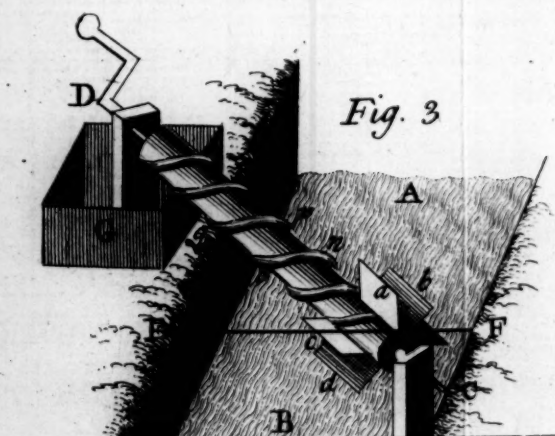
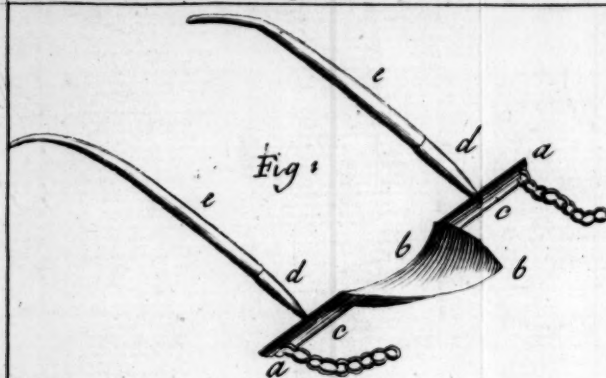


Fig. 2

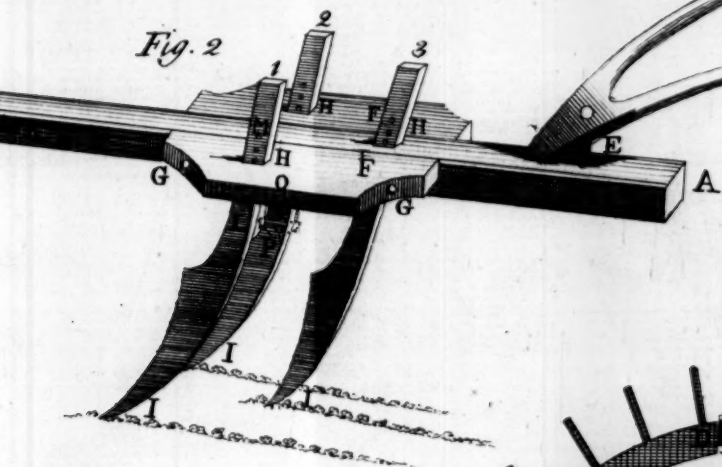


Fig. 8

M. de Lille's Scythe
for mowing Wheat.



Fig. 7

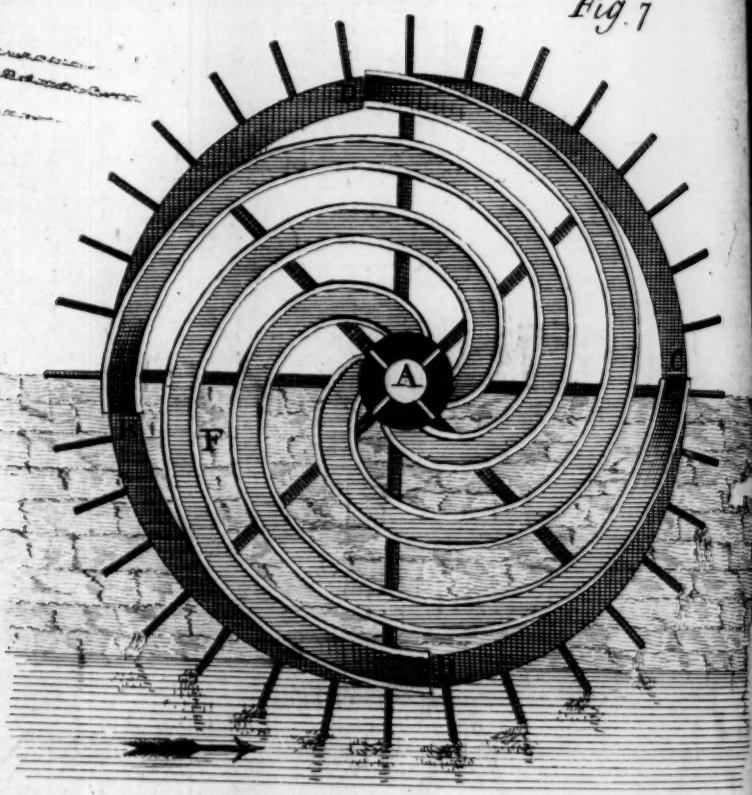


Fig. 6

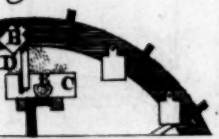
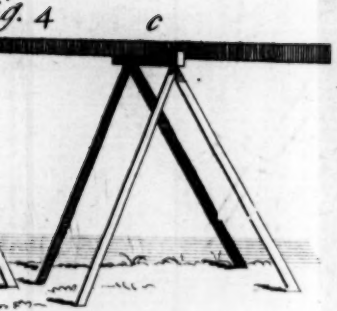


Fig. 4



And he adds, that sainfoin is observed to enrich whatever ground it is planted on, even though a crop be taken off it yearly.

This is confirmed by the author of the *New System of Agriculture*, who says^t; “ There is a foreign grass much properer for light lands, than clover: ’tis generally known by the name of *St. Foine*; but that which I have seen in several parts of Berkshire, Wiltshire, Somersetshire, and many other counties, is a bastard fort; and much inferior to the true *St. Foine* †, which may be had, very reasonably, from Dunkirk, or Calais, and is yearly imported in great quantities, and sold in the seed-shops at London and elsewhere. — As to the time of letting it grow, that may, if you please, be five years, for so long it will continue in it’s prime perfection ‡; and, running into a large knotty root, does so enrich the ground it grows on, that, after it has borne *saint foyne* five years, it will afford three excellent crops of what corn you please; and so improve

^t p. 224.

† M. Duhamel, in his *Elements of Agriculture*^u, distinguishes three sorts of sainfoin; *viz.* the large fort, which is that I have been speaking of, and which is the best; a smaller fort, with more prickly pods; and a large fort which comes from Spain. This last bears very red flowers, and yields a great deal of fodder; but it cannot bear hard frosts.

‡ Though this author limits the prime perfection of sainfoin to five years, in the common husbandry; it will continue equally flourishing a much longer time, when cultivated according to the new method. However, M. Duhamel, who prefers this plant before clover and even before lucerne, for the health of cattle, agrees with him, that, as sainfoin will grow in almost any soil, and always enriches greatly that where it does grow, it is the farmer’s interest not to continue it very long upon the same ground. Mr. Tull differs from M. Duhamel in allowing sainfoin only the next place after lucerne x.

^u *Tom. II. Liv. 9. c. 2. ART. 2.*

Horse-hoeing Husbandry, c. 12.

“ itself

“ itself, by alternate burthens of grafs and grain,
 “ till it arrives at the utmost perfection which land
 “ is capable of reaching.—Nothing is so sweet,
 “ nothing so innocent, nothing so nourishing as
 “ this *saint foyne*; but, above all, it is observed to
 “ increafe milk, in quantity, and quality, beyond
 “ any grafs yet known.”

Experiments on Sainfoin.

IT is with fingular pleasure that I embrace this opportunity of giving the best and most judicious series of experiments that I have yet been favoured with by any of my countrymen; and what adds greatly to my satisfaction on this occasion, is, that they are communicated by a gentleman of distinguished rank and fortune, in Yorkshire, who, though he does not permit me to mention his name, is pleased to allow me to impart them to the public, for whose benefit he generously intends them. His patriotic spirit, and excellent instructions, will appear most conspicuously in his own words, of which I shall therefore give a faithful transcript: in hopes that others may be thereby induced to emulate the noble example thus set them, of contributing to the real welfare of their country.—England has her Turbillys: but, unfortunately, they are unwilling to shew themselves.

“ From an entire conviction,” says this *good Husbandman**, “ that it is the duty of every subject to contribute all in his power to the good of society; I have endeavoured, during several years that I have resided in the country, to

* *Majores nostri, virum bonum cum laudabant, ita laudabant, bonum agricolam, bonumque colonum. Amplissimè laudari existimabatur, qui ita laudabatur.*

CATO, de re rustica, lib. 1.

“ promote and encourage the advancement of
 “ agriculture. To this end I have made variety
 “ of experiments, on different soils, to prove and
 “ ascertain the most beneficial methods of hus-
 “ bandry, or how to employ land to the most ad-
 “ vantage.

“ A great part of my estate, consisting of waste
 “ and uncultivated heath, which did not let for
 “ more than a shilling an acre, I judged it to be a
 “ matter of importance to try if it was not possible,
 “ by culture, or by applying this ground to a dif-
 “ ferent purpose, to increase the value of it.
 “ Happy would it be, could pleasure be made to
 “ coincide with profit! and it is certain, that who-
 “ ever succeeds in the improvement of his own
 “ estate, may enjoy the inward satisfaction of ren-
 “ dering some service to his country: for the ex-
 “ ample of a landlord may be thought to have
 “ some weight with his tenants; and if, amidst a
 “ great number of experiments made for the sake
 “ of truth, some have proved successful, one may
 “ expect that the farmer will at last adopt a meth-
 “ od which he has for many years seen repeated
 “ with advantage: for however the common far-
 “ mer may have been accused of an obstinate ad-
 “ herence to old customs, many instances might
 “ be produced of his quitting the paths of his
 “ ancestors in favour of modern improvements;
 “ but then he must be thoroughly satisfied, that the
 “ new way is indeed preferable to the old, not in
 “ theory only, but in practice, confirmed by ac-
 “ tual experiments often repeated before his eyes.
 “ And can we justly blame the illiterate peasant
 “ for refusing to forsake a method he is well ac-
 “ quainted with, and can depend on for the sup-
 “ port of himself and family, upon other terms?
 “ It is the province of the landlord to adopt a
 “ theory, and to try it by experiment; for if it
 Vol. III. Q “ fails,

“ fails, as is often the case, his ruin is by no means the consequence, and the loss is amply made up to him, by the secret pleasure always accompanying a good intention. But whatever service a gentleman may be of in encouraging researches of this nature, or by his influence in his own neighbourhood; yet ought his benevolence to extend farther, so as to be of use, if possible, to his country and mankind. It is the desire of communicating the little knowledge I may have gained from the experience of a few years, that has prompted me to address this letter to you, who are engaged in an useful and public undertaking: and you are at full liberty to make use of it, together with the detail of the experiments. They were begun without the least design of making them public, and may therefore be deficient in point of method and order: but they are strictly true.

“ On the 3d of April, 1759, two acres of very sandy land (which had 100 loads of red marle laid on it the year before, and had borne a good crop of oats in 1758) were drilled with sainfoin, on 4 feet ridges in double rows, 11 inch partitions, the intervals 3 feet 1 inch wide, and took $4\frac{1}{2}$ pecks of seed. This was intended to be horse-hoed, as Tull directs; but the land was in such bad tilth, and abounded so with the natural grass, that, after once or twice attempting to destroy it by plowing the intervals, the horse-hoeing scheme was given up, and the sainfoin left to take its chance. However, a few plants remained thinly scattered in the rows (whether this thinness was owing to the badness of the feed, or to it's being sown too deep, I know not, though I rather impute it to the latter cause, as, in sandy land, the shares of the drill are very apt to penetrate too far into the “ ground).

“ ground). These remaining plants flourished ex-
 “ ceedingly from the time of their being sown;
 “ many were in flower the following June, and
 “ afforded a tolerable crop, viz. about a load.
 “ The after-eatage was very good. In 1760, these
 “ plants seemed to have arrived at their perfec-
 “ tion, and the product was two waggon loads,
 “ or about two tons. In 1761, and 1762, this
 “ small close, having had some manure laid on it
 “ yearly, yielded nearly the same quantity of hay;
 “ and it is now let for 40 shillings a year: a much
 “ higher rent than any land is lett for in this neigh-
 “ bourhood, and four times the rent paid for it
 “ before the improvement.

“ N. B. This close of two acres was separated
 “ from another of twenty-seven acres, of so sandy
 “ and dry a nature, that, unless in a wet summer,
 “ the hay upon it was scarce ever worth mowing;
 “ and this experiment was made in order to deter-
 “ mine what improvement the adjoining large
 “ close was capable of, and to experience whether
 “ or no the common opinion, that sainfoin is im-
 “ proper for all sandy and deep soils, be founded
 “ on truth, or only the result of prejudice: for
 “ the reason given for it's disagreeing with this
 “ kind of soil, did not appear to me satisfactory;
 “ and great part of my estate consisting of such
 “ sandy land, it seemed a matter of importance,
 “ to know, whether the great advantage derived
 “ from sainfoin, on some soils, might not also be
 “ applicable to sandy soils.

“ Encouraged by the flourishing condition of the
 “ sainfoin on this small close, I determined to ex-
 “ tend the improvement to the larger one also, as
 “ soon as it could be brought into sufficiently fine
 “ order to be laid down with this grass. Ac-
 “ cordingly, in the winter of 1759, twenty-five
 “ acres were plowed with the five coultered

“ plough, as recommended by M. Duhamel, in
 “ his treatise on the cultivation of land, in order
 “ thereby to prepare the ground for turneps the
 “ ensuing summer: for I look upon this as one
 “ of the best methods of destroying the natural
 “ grass, and preparing the land for any of the
 “ artificial grasses; especially if the turneps are
 “ drilled in rows, and cultivated with the horse-
 “ hoe. The land was plowed level in the spring
 “ of 1760, and into ridges of about five feet
 “ broad in June, and a single row of turneps
 “ was drilled on the middle of each ridge in July:
 “ it is to be observed, that the natural grass was
 “ far from being destroyed by these three plow-
 “ ings; nor could it be entirely so by the subse-
 “ quent hoeings of the turneps; so that it cer-
 “ tainly was a great prejudice to the sainfoin.
 “ The same ground is now sown again with the
 “ same plant: but I would strongly recommend
 “ to those who are inclined to follow this method
 “ on such a soil as I have described, to continue
 “ the culture of turneps, with the horse-hoe, two
 “ years, instead of one: for by this means, the
 “ natural grass and weeds may probably be effec-
 “ tually destroyed. But to return to the experi-
 “ ment: the turneps succeeded as well as could
 “ be expected on such a soil, and without manure:
 “ they were eaten off by sheep, and Scotch cattle,
 “ folded on the land.

“ About four acres, on which the turneps were
 “ the first spent, were plowed level, and after-
 “ wards, *viz.* in November, drilled with sainfoin
 “ in equally distant rows, one foot asunder. They
 “ took about a bushel to an acre. This was an
 “ uncommon, and may be thought an improper
 “ season for the sowing of sainfoin: but I chose
 “ to sow part of the field before winter, and part
 “ in the spring, part with sainfoin mixed with
 “ corn

“ corn, and part with sainfoin alone; in order to
 “ see which method would succeed best, that I
 “ might make it my guide in other places, more
 “ likely to yield good crops.

“ Five or six acres of land were drilled in the
 “ beginning of April 1761, with sainfoin seed, in
 “ rows, at the same distance, and with the same
 “ proportion of seed, as the four acres spoken of
 “ before: about three acres were sowed soon after
 “ with sainfoin and oats, both drilled: and about
 “ twelve acres were drilled with sainfoin and bar-
 “ ley, each in rows, about a foot asunder. The
 “ whole of this field, which contained twenty-
 “ five acres, had been plowed but once since the
 “ turneps; whereas two plowings might have
 “ been better: but, on account of eating them
 “ off with sheep and cattle, there was not time
 “ for it.

“ The three acres sowed with oats in rows a
 “ foot asunder, took four bushels and a half of
 “ seed, and produced a very good crop; by
 “ computation, five quarters to an acre: but the
 “ exact quantity, neither of the oats, nor of the
 “ barley, could be known, on account of it's be-
 “ ing mixed in the barn with corn that grew in
 “ other places. The twelve acres sowed with barley
 “ took seventeen bushels of seed, and produced
 “ a much greater crop than any land in the neigh-
 “ bourhood; though this was a great year for bar-
 “ ley. All the farmers who observed this crop,
 “ allowed that they had never seen finer barley;
 “ and it may be said, without the least exaggera-
 “ tion, to have yielded above five quarters to an
 “ acre. I am convinced that this computation of
 “ five quarters to an acre is a very moderate one;
 “ not only from the number of sheaves, and the
 “ judgment of all who saw it; but likewise be-
 “ cause I had no more than twenty-six acres and

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“ an half of land drilled with barley this year;
 “ and the whole produce, when threshed, amount-
 “ ed to one hundred and twenty-eight quarters
 “ and two bushels; which is very near five quarters
 “ to an acre, taking one part with another: but
 “ these twelve acres bore by much the greatest
 “ crop in proportion, and seven acres of the twenty-
 “ ty-six were sown on beds five feet broad, and
 “ horse-hoed, which never produces so large a
 “ crop.

“ The summer of 1762 was remarkably dry and
 “ bad for grass: many fields hereabouts, of ten
 “ acres, did not produce above a load or two of hay;
 “ but this of twenty-five acres produced twelve
 “ tons of good hay: which, considering that the
 “ sainfoin was not nearly arrived at its perfection,
 “ may be said to be considerable.

“ It was now easy to see in what parts of the
 “ field the sainfoin had succeeded best.

“ The four acres sowed before winter had the
 “ smallest number of plants of sainfoin of any;
 “ perhaps not more than one or two in ten yards:
 “ but this ground abounded so with natural grass,
 “ that this alone furnished a tolerable crop. The
 “ five acres sown in the spring, without corn, did
 “ not abound much less with natural grass, or
 “ more with sainfoin, than the preceding: but
 “ there being a great mixture of the seeds of rye-
 “ grass with all the sainfoin sowed in this field, the
 “ rye-grass appeared distinctly in tufts all along the
 “ rows; and, together with the natural grass,
 “ seemed completely to have covered the surface
 “ of the ground. The rows were much better
 “ stocked with sainfoin plants in the twelve acres
 “ sown with it and barley: but the rye-grass
 “ abounded here likewise.

“ It is remarkable, that the sainfoin flourishes
 “ best in those parts of the field where the land is
 “ most

“ most barren; the reason of which undoubtedly
“ is, that, as scarce any natural grafs, or weeds,
“ arife to choak it there, it's young and tender
“ fhoots have the benefit of the whole pasture, and
“ it's roots are not obftructed in their progrefs by
“ the growth of other plants.

“ Though the greateft part of this field is much
“ underftocked with sainfoin plants, yet it is in a
“ very promifing condition for a good crop of hay
“ this year.

“ I attribute the bad fucces of the sainfoin on
“ the firft four acres, partly to it's being fowed too
“ late, whereby the plants could not acquire much
“ ftrength before winter, which deftroyed many of
“ them; partly to fome violent hurricanes of
“ wind, which blew clouds of fand from one part
“ of the field to another, and overwhelmed many
“ plants; and partly to the fhares going too deep,
“ by which the feed was covered at leaft two inches.
“ The bad condition of the five acres fowed
“ alone in the fpring, I believe to be owing, in
“ fome meafure, to the caufes already affigned, and
“ alfo to the want of protection and fhelter from
“ drought, which corn would have afforded in that
“ very dry foil. Barley does alfo help to ftifle the
“ natural grafs, sainfoin's greateft enemy. The
“ sainfoin which was drilled with barley, looked,
“ as was before obferved, by much the beft: but,
“ indeed fome precautions were ufed to fow the
“ feed fomewhat fhallower on thefe twelve acres;
“ and this may, in fome degree, have contributed
“ to it's fucces.

“ Upon the whole, from the experiments made
“ in this field (and feveral others made fince have
“ ftrengthened my opinion on that head) I con-
“ clude, firft, that sainfoin is very fuitable to any
“ fandy or deep foils, provided they are dry, and
“ that the natural grafs and weeds can by any

“ means be completely destroyed: secondly, that
 “ it is better to sow sainfoin in the spring, and
 “ with barley, than in the autumn, or spring,
 “ alone: thirdly, that the seed should not be co-
 “ vered above an inch deep; but I believe half
 “ an inch the most proper depth. One foot may
 “ be a very proper distance for drilling the rows;
 “ and from a bushel to a bushel and an half, a pro-
 “ per allowance of seed for an acre of ground, pro-
 “ vided that seed be good.

“ I have tried the horse-hoeing of sainfoin sown
 “ on beds three and four feet broad: but, though
 “ the plants do by that means certainly grow more
 “ vigorous, I do not think the crop so great; and
 “ when the stalks are strong and pipy, I have ob-
 “ served that cattle will not eat them. The sowing
 “ in equally distant rows seems preferable, especi-
 “ ally where a large extent of ground is to be
 “ sowed. But my experience is very insufficient
 “ to decide this point absolutely. I could wish that
 “ gentlemen would make trials of the horse-hoeing
 “ of sainfoin in different soils and situations.

“ Experiments carefully made, and often varied,
 “ by persons void of prejudice, may, in time, de-
 “ cide that important question in agriculture, *viz.*
 “ whether the common, or the horse-hoeing, hus-
 “ bandry be, upon the whole, most advantageous
 “ to the English farmer.

“ If sainfoin be drilled on a sandy soil, or on
 “ one that is in very fine order, the shares of the
 “ drill ought to be two inches thick, or they will
 “ go too deep; and a small wooden roller should
 “ be fixed to, and follow, the drill, instead of
 “ a harrow with teeth, which would bring too
 “ much earth upon the seed. Such as a roller will
 “ lay the ground smooth, and fitter for mowing.
 “ A spring made of three pieces of Ash, as de-
 “ scribed

scribed by M. Chateauvieux *, is of great use, and may easily be added to Mr. Tull's drill plough. It may be fastened underneath the middle of the plank, by four screws, and made to press more or less on the roller, or harrow, which ever is made use of, by a wedge put in betwixt the spring and the hinder edge of the plank. If a harrow is used, iron teeth are much preferable to wooden ones.

In the year 1757, I had a mind to try how much a soil naturally extremely bad, could be improved by art. Accordingly I made choice of a piece of ground one acre and a half in extent, a barren sand, which produced only a few miserable weeds, and which the farmer who rented it did not think worth his while to cultivate. There happened to be a great quantity of red stony marle in an adjoining field, of which near 300 loads were laid on this acre and an half. It was drilled with barley in 1758, and horse hoed: but the crop proved a very bad one. In 1759, a load of lime, and about ten loads of dung were laid thereon, and it was drilled with turneps and horse-hoed: however, the crop still was but moderate; though a good deal better than could have been expected from such a soil. In 1760, it had turneps again, managed in the same manner as the former, but they were a great deal better. In 1761, it was drilled with oats, sainfoin and rye-grass, mixed, in equally distant rows one foot asunder. It took two bushels and a peck of oats, and two bushels of grass seeds. The oats were very good, and produced four quarters and four bushels. By continued horse-hoeing three years together, the land was got into perfectly fine order, the marle and sand

* See Vol. II. p. 36.

“ were thoroughly incorporated, and the natural
 “ grass and weeds entirely destroyed: so that the
 “ sainfoin and rye-grass grew and flourished ex-
 “ ceedingly. In 1762, the summer being un-
 “ commonly dry, the produce was about half a
 “ load of hay, which was as much as one could
 “ expect the first year after sowing. It is very
 “ well stocked with plants, which now, in May
 “ 1763, seem as vigorous as in any of my other
 “ fields, though I have some which yield two tons
 “ of hay to an acre. This little piece of ground,
 “ which before was not worth a shilling a year, is,
 “ by the labour and cost bestowed on it, now
 “ worth at least fifteen shillings an acre; which is
 “ a proof that, let land be ever so bad, it may be
 “ improved, and perhaps made equal to the best
 “ in the neighbourhood: but at the same time it
 “ must be confessed, that the expence is too great
 “ to be repeated at once on a large extent of
 “ ground. I calculate that 300 loads of marle,
 “ dug and carried about 300 yards, might cost
 “ about four pence a load, or five pounds for 300
 “ loads, which has been the whole expence at-
 “ tending this acre and half: for the manure,
 “ plowings, and horse-hoeings, were repaid by the
 “ crops of barley, oats, and turneps.”

The experiments mentioned by Mr. Duhamel, relative to the culture of sainfoin, are these.

In 1754, M. Eyma, near Bourdeaux, planted sainfoin, lucerne and clover, in rows eight feet asunder, with distances of sixteen inches between the plants in the rows, which yielded him an immense increase. The alleys were horse-hoed after each cutting ^a.

In 1755, he planted a field, a little more than three roods square, with sainfoin, which he culti-

^a *Culture des Terres*, Tom. IV. c. 1. p. 25.

vated according to the rules of the new husbandry; and this spot yielded him 10,000 pounds of dry hay. M. de Chateauvieux had 15,300 pounds of lucerne, as we shall see, off somewhere more than an acre of ground, which he cut five times: but M. Eyma thinks that 14445 pounds, Geneva weight, of sainfoin, which he had at another time, at one cutting, is a greater crop than M. de Chateauvieux's lucerne; besides the after crop which indeed was but inconsiderable, on account of the dryness of the season. He says he cuts his sainfoin three times in good years, and that the two last cuttings produce nearly as much as the first: but he allows, that such years are not to be expected often^b.

M. Eyma doubts whether the preference be due to sainfoin, or to lucerne: but he is confident that either of them, properly cultivated, will produce surprising crops.

He thinks that one row of sainfoin, or lucerne, planted in the middle of a bed three feet wide, will profit more by the different hoeings, and consequently produce more grass, than double or triple rows, though these last be planted on broader beds; because the single rows have the earth loosened on each side of them.

M. Diancourt sowed sainfoin, each plant of which, in 1753, had a head of two feet diameter. They throve so well, that, in 1755, one plant, and that not the largest in the field, yielded 23 ounces of hay^c.

^b *Ibid.* Tom. V, c. 1. p. 73.

^c *Ibid.* p. 7.

ARTICLE II.

OF LUCERNE.

EIGHT species of this plant are distinguished by Mr. Miller: but J. Bauhin's *Medica major, erectior, floribus purpurascens*, greater upright Medic, with purplish flowers, is that which is cultivated for the food of cattle, and, in all probability, the *Medica* of Virgil, Columella, Palladius, and other ancient writers of husbandry. It is the *Alfafa* of the Spaniards, and the *Lucerne, grand Trefle*, or *Fenum Burgundiacum*, as some botanists call it, of the French. It has a perennial root, and an annual stalk, which rises full three feet high in good land, and is garnished, at each joint, with trifoliate leaves, whose lobes are spear-shaped, about an inch and a half long, and half an inch broad, sawed towards their stalks. The flowers grow in spikes, which are from two, to near three inches in length, standing upon naked foot-stalks two inches long, rising from the wings of the stalks: they are of the pea bloom, or butterfly kind; of a fine purple colour, and are succeeded by compressed moon-shaped pods, which contain several kidney-shaped seeds. It flowers in June, and its seeds ripen in September.

There are the following varieties of this species of lucerne, viz. one with violet coloured flowers; another with yellow flowers; a third with yellow and violet flowers mixed; and a fourth with variegated flowers: but, as Mr. Miller observes^a, these are only variations of the same plant, arising accidentally from the seed. However, neither the yellow, nor the variegated, flowered lucerne is

^a *Gardener's Dict. Art. MEDICA.*

ever so strong as that with purple flowers, nor is it, consequently, so profitable to the husbandman.

Columella calls this^b the choicest of all fodder, because it will last ten years*, and will bear being cut down four, and sometimes six times in a year; because it enriches the land on which it grows, fattens the cattle fed with it, and is a remedy for sick cattle; and because a *jugerum* (about three quarters of an acre) of it is abundantly sufficient to feed three horses during the whole year.

This plant is supposed to have taken it's name *medica*, from *Media*, whither Darius Hytaspes is said to have carried great quantities of it for provender for his horses, when he invaded Greece, and by that means it's seeds were scattered there. Whether the Romans had it first from thence, when they conquered that country, I shall not pretend to say: but certain it is, that they esteemed it highly, as appears from all their authors who have treated of rural affairs.

Yet, notwithstanding it was so much esteemed by the ancients, and hath been cultivated to great advantage in France and Switzerland for many years, it has not yet found so good a reception in England as it justly deserves, nor is it cultivated here in any considerable quantity, though it will succeed as well in this country as in either of the last mentioned; being extremely hardy, and resisting the severest cold of our climate; as a proof of which Mr. Miller observes, that the seeds which have happened to be scattered upon the ground in autumn, have come up, and the plants, after enduring the cold of a severe winter,

^b *De Re rustica*, Lib. II. c. 11.

* We shall find that it will last even much longer: Pliny, indeed, says thirty years.

have

have been very fine and strong. He continues thus^c.

“ About the year 1650, the seeds of this plant
 “ were brought over from France, and sown in
 “ England: but whether for want of skill in it’s
 “ culture, whereby it did not succeed, or that the
 “ people were so fond of going on in their old
 “ beaten road, as not to try whether it would suc-
 “ ceed here or not, was the occasion of it’s being
 “ entirely neglected in England, I cannot say:
 “ but it is very certain that it was neglected many
 “ years, so as to be almost forgotten. However,
 “ I hope, before I quit this article, to give such
 “ directions for it’s culture, as will encourage the
 “ people of England to make a further trial of this
 “ valuable plant, which grows in the greatest heat,
 “ and also in very cold countries, with this differ-
 “ ence only, that in very hot countries, such as the
 “ Spanish West-Indies, &c. where it is the chief
 “ fodder for their cattle at this time, they cut it
 “ every week; whereas in cold countries it is sel-
 “ dom cut oftener than three or four times a year.
 “ And it is very likely, that this plant will be of
 “ great service to the inhabitants of Barbadoes,
 “ Jamaica, and the other hot islands in the West-
 “ Indies, where one of the greatest things they
 “ want is fodder for their cattle: since by the ac-
 “ count given of this plant by F. Feuillé, it
 “ thrives exceedingly in the Spanish West-Indies,
 “ particularly about Lima, where they cut it every
 “ week, and bring it into the market to sell, and
 “ is there the only fodder cultivated.

“ It is also very common in Languedoc, Pro-
 “ vence, and Dauphiné, and all over the banks of
 “ the Rhône, where it produces abundantly, and
 “ may be mowed five or six times in a year. Horses,

^c *Gardener’s Dict. ubi supra.*

“ mules,

“ mules, oxen, and other domestic cattle, love
 “ it exceedingly; but above all when it is green,
 “ if they are permitted to feed on it, and especially
 “ the black cattle, which will feed very kindly up-
 “ on the dried plant, the excess of which is, by
 “ many people, thought to be very dangerous:
 “ but it is said to be exceeding good for milch cat-
 “ tle, to promote their quantity of milk; and is
 “ also said to agree with horses the best of all,
 “ though sheep, goats, and most other cattle, will
 “ feed upon it, especially when young.

“ The directions given by all those who have
 “ written of the culture of this plant are very im-
 “ perfect*; for most of them order the mixing
 “ of this seed with oats or barley (as is practised
 “ for clover;) but in this way it seldom comes
 “ up well; and if it does, it will draw up so weak
 “ by growing amongst the corn, as not to be re-
 “ covered under a whole year, if ever it can be
 “ brought to it's usual strength again.

“ Others have directed it to be sown upon a
 “ low rich moist soil; which is found to be the
 “ worst next to a clay, of any for this plant; in
 “ both which the roots will rot in winter, and in a
 “ year or two the whole crop will be destroyed.

“ The soil in which this plant is found to suc-
 “ ceed best in this country is, a light, dry, loose,
 “ sandy land, which should be well plowed and
 “ dressed, and the roots of all noxious weeds,
 “ such as couch-grass, &c. destroyed; otherwise
 “ these will over-grow the plants while young,
 “ and prevent their progress.

“ The best time to sow the seed is about the
 “ middle of April, when the weather is settled
 “ and fair: for if you sow it when the ground is

* I believe that M. de Chateaufvieux's directions, and his
 experiments, will appear in a different light.

“very wet, or in a rainy season, the seeds will
 “burst and come to nothing (as is often the case
 “with several of the leguminous plants); there-
 “fore you should always observe to sow it in a
 “dry season, and if there happens some rain in
 “about a week or ten days after it is sown, the
 “plants will soon appear above ground.”

The frequent bad success of the culture of this plant, when sown in broad cast, has been, in a great measure, owing to the quantity of natural grass which grows with it, and chokes it. Columella cautions the husbandman particularly against this enemy; and some gentlemen who have lately attempted to clear their lucerne of the grass and weeds, by drawing a drag-harrow across the ground, have found this labour attended with considerable advantage. Mr. Rocque has improved this practice, and made it answer far beyond any thing that one would expect from his description of it; as appears by the constantly thriving state of his plants, and the great returns of his crops. His directions are to this effect.

“Prefer the strongest and deepest land; because, though lucerne will grow on almost any soil where water does not stand in the winter so as to rot it's roots, that will afford the best crops, if it has been sufficiently plowed and harrowed, in proportion to it's stiffness, and thoroughly cleaned from all sorts of weeds, as is done for barley. When the ground has been brought to this fine tilth, by which it will have been well mellowed and sweetened, manure it just before the last plowing, not with old rotten stuff, as is usually done, but with fresh stable dung that has been thrown up in a hill three or four weeks to ferment; and let this be laid on when in it's full fermentation,

and plowed in as soon as possible that the salts of the dung may not have time to evaporate: then harrow the land, sow it broad cast (not in drills), and harrow the seed in with a light harrow or a bulh harrow; and lastly, run a roller over it, to settle the ground and break the clods. About fourteen pounds of seed are the proper allowance for an acre, if it be sown alone: but if corn is to be sowed among it, half that quantity will be sufficient. Sowing it alone is by much the best way, because the corn will always be apt to destroy the lucerne, especially if the former be strong, and the season prove wet.

“ In Languedoc, no corn is sown with it, and the lucerne is mowed when it is six or seven inches high; by which means all the heads of annual weeds are cut off, and prevented from feeding.

“ In Normandy, where the climate is much the same as in England, corn is sowed with the lucerne.

“ In Picardy, and about Paris, some sow it with corn, and others without.

“ About Avignon, when the lucerne begins to decline, the ground is manured and plowed anew, and sown with corn and lucerne. The old roots then shoot up again with the seed, and make another fine crop: for the plowing does not hurt them.

“ If a full crop of barley is sowed with the lucerne, and the barley grows very strong, the best way is to mow down the barley when it is in ear.

“ Fresh broke up land should be tilled a year or two before it is sowed with lucerne. Peas and beans for one year will help to prepare it well; but potatoes excel all other plants for sweetening and mellowing the soil. The next year, a fallow for turneps will be proper; and if these are fed

off with sheep, the ground will be greatly enriched thereby.

“ If forward peas are sown on land newly broken up, in order to prepare it for lucerne, a crop of turneps may succeed as soon as the peas are taken off, and the turneps may be fit to feed off by Christmas. As soon as they are removed, plow the ground, and let it lie fallow till a proper time to stir it again, or give it a trench plowing, which will be of great service, either now or at the very first.

“ Lucerne may be sown from the beginning of March to the end of May: but April, if the weather be dry, is the best time. Later than May would be hazardous; because there is then most danger of drought, and consequently of the young plants being eaten up by the fly.

“ If much wet falls on the new sown lucerne, it will be apt to swell too fast, and burst: but if the weather continues fine for three or four days after the sowing, that danger will be over.

“ When the lucerne is a year old, go over the whole ground with a large harrow, as often as is sufficient to root up the annual weeds and grafs. This must be done in dry weather, that the weeds and grafs may be killed before the lucerne begins to sprout, which is very early in the spring: and at the same time, if you see any patches where the seed has miscarried, a little seed should be sprinkled over them, and harrowed in: or, which will amply repay the expence with a large crop, give them first a dressing with rotten dung.

“ The harrow will not hurt the lucerne, whose roots are very tough: and if it should cut, or wound, any of them, they will nevertheless sprout and grow.

“ In the second spring after sowing, plow the ground where the lucerne grows, with a drill plough,

plough; with a round share, without a fin and feather, and without a coulter, that the roots may not be hurt too much. Let it lie rough a few days, to dry and mellow; and then, in fair weather, harrow it down fine, that it may be mowed the closer.

“ This spring plowing among the lucerne must be repeated annually. It kills the grass and weeds, and makes the ground ferment, which promotes vegetation: and the oftener it is refreshed with a little dung on the surface, the better the crops will be. If the dung be laid on before the winter, that it's salts may be washed in by the rain and snow, and if it be plowed in, in the spring, it will greatly add to the cultivator's profit.

“ Lucerne is the most profitable of any sort of fodder to feed horses with in the summer, by mowing it, and giving it to them green. It's produce will be proportioned to the goodness and depth of the soil. In excellent land, properly tilled, it will be almost incredible. Mr. Rocque has seen it mowed five times in a season, and it has yielded, at the five mowings, near eight loads of hay on an acre. But in this case, indeed, it has not been let run to seed.

“ If it be let stand too long before it is mowed, it's stalks will be too hard for cattle to eat them, and it will lose much of it's goodness.

“ To make hay of lucerne, it should be mowed as soon as the bloom appears, or rather sooner. It must not be spread, like common grass, but must lie in swarth, as is practised for clover, like which it must also be turned: otherwise it's leaves will drop off.

“ This hay is good for all sorts of cattle; and when horses are fed with it, they must not have their otherwise full allowance of corn; the lucerne

answering, in a great measure, the purpose of both corn and hay.

“ In hot summers, the seed of the lucerne may be sowed in England, but not from the first growth; that being generally too rank, and subject to rot at bottom. In Languedoc, it is sowed from the third growth; but as this climate is colder, it will not have time to ripen, if it be not sowed from the second growth. A dry soil is the best to sow it upon, because it is not so apt to grow rank there; and in this case it may possibly do from the first growth. It will be ripe in September, and must be gathered by hand.”

To these directions Mr. Rocque adds, that a person who has not been used to the culture of lucerne will be apt to think the plants must be destroyed by harrowing or plowing among them; but that he can shew any gentleman who will take the trouble to call at his house (at Walham Green), that experience teaches the contrary.

The harrow with which he weeds his lucerne has two handles, like a plough, instead of which it may sometimes be used in light land, so as even to save some labour. The teeth are seven or eight inches asunder in the first row, and project about five inches beyond the wood. The second row is placed nine or ten inches behind the first, and in such manner that its teeth are opposite to the spaces in the former row. The teeth of this second row are an inch longer than those in the first; so that, the ground being loosened a little by the first row, these go somewhat deeper; and the teeth of the third and last row are an inch longer than those of the second, and placed so as to go in the same track as the teeth of the first row.

This harrow is made of one solid piece of wood, four or five inches thick, and its lower side is rounded

rounded off towards the hinder part, where the teeth are longest: by which means the person who holds it by the handles, pressing down a little, may force the second and third rows of teeth deeper than the first; and, by bearing up a little, he may prevent any but the first row from working. A very little practise will enable any one to use it as occasion requires; and Mr. Rocque says it will be so steady, that no unevenness of the ground will be able to throw it out of it's work, as a clod, or stone, will do a common harrow.

Mr. Rocque's method may answer very well in light mellow ground; though I fear it will not where the land is strong and binding. This last is, indeed, a soil on which lucerne is very seldom sown, and which almost all writers have declared to be improper for it. But I have the pleasure of acquainting the reader, that an experiment made in Surrey, on a strong clay, has evinced their mistake, and now proves, that this plant will succeed on a soil of that kind, full as well as on any other, if it be properly managed.

The gentleman to whom I owe the certainty of this fact, but whose name I am not at liberty to mention; too active, and too prudent, to loiter away his time, like many of his brother officers, devotes his attention, when relieved from military duty, to his own real emolument, and to the peaceful service of his country. In this laudable pursuit, he determined to try what good culture would effect on such a soil. To this end he drilled three acres with lucerne, which he weeded carefully the first year; and from the places where it grew too thick, he supplied those in which it had failed. He contrived a horse-hoe, somewhat in the manner of M. de Chateauvieux's cultivator, very easily drawn by one horse. After every weeding, he stirred the alleys with this cultivator,

which manifestly revived his plants. They thrive greatly the second year, and are now, which is their third, in such perfection, that he has fed five horses on the produce of their cuttings, ever since the middle of May, and they cannot consume the whole of it. The constant rains during this last month of July have prevented his making any of it into hay, which he intends to do as soon as the season will permit. These horses, though constantly worked very hard, have not had either corn or hay during all this time; and yet they continue in strength and spirit, and grow fat. A horse which, in May, was so weak, and in so bad a state, that it was thought he could not live, soon recovered when he was fed with lucerne, and was continued in a constant labour, which, in the opinion of all who saw him, he could not have executed, had it not been for this food. The plants were about three feet high at the first cutting, and, in general, between three feet and three feet and a half at the second, and grew in so large tufts, that no distance appeared between the drills.

After every cutting, this judicious experimenter hoes the alleys with what I call his cultivator; and if he finds that the weeds have not been sufficiently destroyed thereby, he uses a paring hoe, like that described in the first volume of this work (page 216, note*, and *Pl. III. Fig. 8*), excepting that the standards, or upright pieces, there marked C C, pass through an axle-tree, instead of the block B, and are pinned thereto, at whatever height is thought most proper, so as to be made to enter into the earth to any depth desired. The ends of this axle-tree pass through two wheels, and shafts are fixed to it (only one horse being used here), instead of the pole and fore-carriage in the above-mentioned engine. With this hoe, the
roots

roots of all weeds in the alleys are cut asunder under the surface of the earth, and their severed heads soon wither, or may easily be carried off the ground.

It is manifest that these three acres of lucerne would more than maintain six horses during the summer and autumn; which, computing the rent of the land, and the small expence attending the culture of this plant, will be found to be a very great saving, when compared with the price of the hay and corn necessary for such horses, in the common way.

Mr. Miller's directions are agreeable to this gentleman's practice, when he advises the following method of cultivating lucerne.

" After having well plowed and harrowed the
 " land very fine, you should make a drill quite
 " a-crofs the ground, almost half an inch deep, into
 " which the seeds should be scattered very thin :
 " then cover them over a quarter of an inch thick,
 " or somewhat more, with the earth: then pro-
 " ceed to make another drill, about a foot and a
 " half from the former, sowing the seeds therein
 " in the same manner as before, and so proceed
 " through the whole spot of ground, allowing
 " the same distance between row and row, and
 " scatter the seeds very thin in the drills. In
 " this manner, an acre of land will require about
 " six pounds of seed: for when it is sown thicker,
 " if the seeds grow well, the plants will be so
 " close as to spoil each other in a year or two, the
 " heads of them growing to a considerable size,
 " as will also the roots provided they have room.
 " I have measured the crown of one root, which
 " was in my possession, eighteen inches diameter;
 " from which I cut near four hundred shoots at
 " one time, which is an extraordinary increase, and
 " this upon a poor dry gravelly soil, which had

“ not been dunged for many years; but the root
 “ was at least ten years old; so that if this crop
 “ be well cultivated, it will continue many years*,
 “ and be equally good as when it was first sown :
 “ for the roots generally run down very deep in
 “ the ground, provided the soil be dry; and al-
 “ though they should meet a hard gravel a foot
 “ below the surface, yet their roots would pene-
 “ trate it, and make their way downward, as I
 “ have experienced, having taken up some of
 “ them, which were above a yard in length, and
 “ had run two feet into a rock of gravel, so hard
 “ as not to be loosened without mattocks and
 “ crows of iron, and that with much difficulty.
 “ The reason for directing this seed to be sown
 “ in rows is, that the plants may have room to
 “ grow; and for the better stirring the ground
 “ between them, to destroy the weeds, and en-
 “ courage the growth of the plants, which may
 “ be very easily effected with a Dutch hoe, just after
 “ the cutting the crop each time, which will cause
 “ the plants to shoot again in a very little time, and
 “ be much stronger than in such places where the
 “ ground cannot be stirred : but when the plants
 “ first come up, the ground between should be
 “ hoed with a common hoe; and if in doing of this
 “ you cut up the plants where they are too thick,
 “ it will cause the remaining to be much stronger.
 “ This hoeing should be repeated two or three
 “ times while the plants are young, according as
 “ the weeds are produced, observing always to do
 “ it in dry weather, that the weeds may the better

* M. Duhamel likewise says, that it will continue a long
 time on the same ground, if care be taken that the natural grass
 or weeds do not choak it; for as soon as any other plants come
 up among lucerne, it decays gradually and dies, so that very
 little of it will remain at the end of a few years.

“ be

“ be destroyed; for if it be done in moist weather,
“ they will root and grow again.

“ With this management, the plants will grow
“ to the height of two feet, or more, by the begin-
“ ning of August, when the flowers will begin to
“ appear, at which time the lucerne should be
“ cut, observing to do it in a dry season, if it is
“ to be made hay, and keep it often turned, that
“ it may soon dry, and be carried off the ground;
“ for if it lie long upon the roots, it will prevent
“ their shooting again. After the crop is taken
“ off, you should stir the ground between the rows
“ with a hoe, to kill the weeds, and loosen the
“ surface, which will cause the plants to shoot out
“ again in a short time, so that by the beginning
“ of September there will be shoots four or five
“ inches high, when you may turn in sheep upon
“ it to feed it down: nor should the shoots be
“ suffered to remain upon the plants, which would
“ decay when the frosty weather comes on, and
“ fall down upon the crown of the roots, and
“ prevent their shooting early the succeeding
“ spring.

“ The best way therefore is to feed it until
“ November, when it will have done shooting for
“ that season: but it should not be fed by large
“ cattle the first year, because the roots being
“ young, would be in danger of being destroyed,
“ either by their trampling upon them, or their
“ pulling them out of the ground: but sheep
“ will be of service to the roots by dunging the
“ ground, provided they do not eat it too close,
“ so as to endanger the crown of the roots.

“ In the beginning of February, the ground be-
“ tween the rows should be again stirred with the
“ hoe, to encourage them to shoot again: but in
“ doing of this you should be careful not to
“ injure the crown of the roots, upon which the
“ buds

“buds are at that time very turgid, and ready to
“push. With this management, if the soil be-
“warm, by the middle of March the shoots will
“be five or six inches high, when, if you are in
“want of fodder, you may feed it down till a
“week in April; after which it should be suffered
“to grow for a crop, which will be fit to cut the
“beginning of June, when you should observe to
“get it off the ground as soon as possible, and
“stir the ground again with the Dutch hoe, which
“will forward the plants shooting again, so that
“by the middle, or latter end of July, there will
“be another crop fit to cut, which must be ma-
“naged as before; after which it should be fed
“down again in autumn: and as the roots by this
“time will have taken deep hold in the ground,
“there will be little danger of hurting them,
“if you should turn in larger cattle; but you
“must always observe not to suffer them to
“remain after the roots have done shooting, lest
“they should eat down the crown of the roots
“below the buds, which would considerably
“damage, if not destroy them.

“In this manner you may continue constantly
“to have two crops to cut, and two feedings upon
“this plant, and in good seasons there may be
“three crops cut, and two feedings, which
“will be a great improvement, especially as this
“plant will grow upon dry barren soils, where
“grafs will come to little, and be of great use in
“dry summers, when grafs is often burnt up:
“and as it is an early plant in the spring, so it
“will be of great service when fodder falls short
“at that season, when it will be fit to feed at least
“a month before grafs or clover; for I have had
“this plant eight inches high by the tenth of
“March, old style, at which time the grafs in the
“same place has scarcely been one inch high.

“That

“ That cold will not injure this plant, I am fully
“ satisfied *; for in the very cold winter, Anno
“ 1728—9, I had some roots of this plant which
“ where dug up in October, and laid upon the
“ ground in the open air till the beginning of
“ March. when I planted them again, and they
“ shot out very vigorously soon after: nay, even
“ while they lay upon the ground, they struck out
“ fibres from the under side of the roots, and had
“ begun to shoot green from the crown of the
“ roots. But that wet will destroy the roots, I am
“ fully convinced; for I sowed a little of the seed
“ upon a moist spot of ground for a trial, which
“ came up very well, and flourished exceedingly
“ during the summer season, but in winter, when
“ the great rains fell, the roots began to rot
“ at bottom, and before the spring most of them
“ were destroyed,

“ The best places to procure the seed from, are
“ Switzerland and the northern parts of France,
“ which succeeds better with us than that which
“ comes from a more southern climate: but
“ this seed may be saved in England in great
“ plenty; in order to which, a small quantity of
“ the plants should be suffered to grow uncut till
“ the seeds are ripe, when it must be cut, and laid
“ to dry in an open barn where the air may freely
“ pass through: but the seed must be defended
“ from the wet; for if it be exposed thereto, it
“ will shoot while it remains in the pod, whereby
“ it will be spoiled. When it is quite dry, it must
“ be threshed out, and cleansed from the husk,
“ and preserved in a dry place till the season for
“ sowing it: and this seed saved in England is

* This is confirmed by M. Duhamel, who says that the hard winter in 1709, which killed almost all the olive trees in France, did no great damage to the lucerne.

“ much

“ much preferable to any brought from abroad,
 “ as I have several times experienced; the plants
 “ produced from it having been much stronger
 “ than those produced from the French, Helve-
 “ tian, and Turkey seeds, which were sown at the
 “ same time, and on the same soil and situation.

“ I am inclinable to think that the reason of
 “ this plant’s not succeeding, when it has been sown
 “ in England, has either been occasioned by the
 “ sowing it with corn, with which it will by no
 “ means thrive* (for though the plant be very
 “ hardy when grown pretty large, yet at it’s first
 “ coming up, if it be incommoded by any other
 “ plant or weeds, it seldom does well; therefore
 “ it should always be sown by itself, and carefully
 “ cleared from weeds until it has strength, after
 “ which it is not easily destroyed;) or, perhaps,
 “ people have sown it at a wrong season, or in
 “ wet weather, whereby the seeds have rotted, and
 “ never come up, which hath discouraged their
 “ attempting it again: but however the success
 “ has been, I dare aver, that if the method of
 “ sowing or managing of this plant, which is here
 “ laid down, be duly followed, it will be found to
 “ thrive as well as any other sort of fodder now
 “ cultivated in England, and will continue much
 “ longer: for if the ground be duly stirred after the
 “ cutting of each crop, and the first crop fed, as
 “ hath been directed, the plants will continue in
 “ vigour twenty years, or more, without renewing,
 “ provided they are not permitted to seed, which
 “ would weaken the roots more than four times
 “ cutting would do.

“ The hay of this plant should be kept in close
 “ barns, it being too tender to be kept in ricks

* M. Duhamel also is absolutely against sowing it with corn,
 or any other plant,

“ open to the air as other hay : but it will remain
“ good, if well dried before it be carried in, three
“ years. The people abroad reckon an acre of
“ this fodder sufficient to keep three horses all the
“ year round: and I have been assured by persons
“ of undoubted credit, who have cultivated this
“ plant in England, that three acres of it have
“ fed ten cart horses from the end of April to the
“ beginning of October, without any other food,
“ though they have been constantly worked. In-
“ deed the best use that can be made of this grass
“ is, to cut it and give it green to the cattle.
“ Where this has been daily practised, I have
“ observed that by the time the field has been cut
“ over, that part which was first cut, hath been
“ ready to cut again; so that there has been a
“ constant supply in the same field, from the mid-
“ dle of April to the end of October, when the
“ season has continued long mild; and when the
“ summers have proved showery, I have known
“ six crops cut in one season: but in the dry sea-
“ sons there will be always three. When the plant
“ begins to flower, it should then be cut; for if
“ it stands longer, the stalks will grow hard, and
“ the under leaves will decay, and then the cattle
“ will not so readily eat it. Where there is a
“ quantity of this cultivated, some of it should
“ be cut before the flowers appear, otherwise
“ there will be too much to cut within a proper
“ time.

“ When this is made into hay, it will require a
“ great deal of making: for as the stalks are
“ very succulent, it must be often turned, and ex-
“ posed a fortnight before it be fit to house; and
“ this requires a longer time to make than sain-
“ foin: therefore, when it is cut, it should be
“ carried to make upon some grass ground; be-
“ cause the earth in the intervals of the rows
“ will

“ will wash up, and mix with the hay in every shower
 “ of rain; and by carrying it off as soon as it is
 “ cut, the plants will shoot out again soon: but it
 “ is not so profitable for hay, as to cut green for
 “ all sorts of cattle, but especially horses, which
 “ are extremely fond of it; and to them it will
 “ answer the purpose of both hay and corn, and
 “ they may be worked at the same time just as
 “ much as when they are fed with corn; or dry
 “ food.”

To these instructions of Mr. Miller, I shall only add a few remarks made by M. Duhamel^a, and then proceed to the experiments which some of his correspondents, and particularly M. de Chateauvieux, have made upon the culture of lucerne according to the principles of the new husbandry.

Lucerne, like sainfoin, may be cut, either before it blossoms, while it is in bloom, or when the seed is ripe. The only things to be observed are,

1. That it makes the best fodder, when cut before it's lateral shoots come out, and consequently a good while before it blossoms.

2. That the earlier it is cut, the sooner it produces a new crop.

3. That lucerne requires more time to dry it into hay, than sainfoin: but yet it must not be left long upon the field, lest it should heat, and damage the young shoots rising for another crop.

4. That rain hurts lucerne, when cut, more than it does sainfoin. It should therefore be housed as soon as it is dry: for this hay cannot be pressed so close together, in cocks, but that the water will penetrate into it, and rot it.

5. If lucerne grows yellow before it is in bloom, it is an almost certain sign that it's root

^a *Culture des Terres, Tom. I. c. 27. p. 107.*

is attacked by some insect in the earth. The best way in this case is to cut it down, that the grass may not be lost, and that the insects may be destroyed before they entirely consume the root.

6. When the seed is to be saved, it must stand till it is quite ripe, and that crop of grass is lost.

When the seed is quite ripe, the tops of the plants, where the pods grow, should be cut off with a sharp sickle, (shaking them as little as possible,) and laid in a cloth held ready to receive them, on which they are dried in the shade, and then beat out and cleaned. The rest of the grass is afterwards cut down; rather to clear the field, than for any use it can be of; being then too coarse and hard.

Experiments on Lucerne cultivated according to the new husbandry, by M. DE CHATEAUVIEUX.

"IT is truly with regret, says M. de Chateauxvieux^b, that I am forced to treat a subject of this importance, in so summary a way as the limits of this letter * require. However, I hope that even this general account of my experiments may be a guide to those who would cultivate this plant. Many persons who live at a considerable distance from this place †, have already followed my example, and are extremely well satisfied with their success.

" Though I agree with M. Duhamel and the other partisans of new husbandry, that lucerne and sainfoin thrive best when cultivated in beds; yet my practice differs, in many respects, from theirs. This difference consists in,

^b *Culture des Terres, Tom. IV. c. 3. art. 15.*

* His letter to M. Duhamel.

† Geneva.

1. *The principle which I apply particularly to the culture of Lucerne.*

LUCERNE grows naturally with one large perpendicular, or tap, root, which penetrates very deep into the earth, and has few, if any, lateral roots. From similar experiments on other tap-rooted plants, I was induced to think, that this too, by transplanting it, and at the same time cutting off part of it's tap-root, might be made to shoot out several horizontal roots, which, reaching into the loose mould of the alleys, and extending themselves there, would collect a greater quantity of nourishment for the plant, and consequently enable it to produce more abundant crops.

“ The event has proved, that when we reason on sound principles, we seldom err. My transplanted lucerne pushed out numbers of large lateral roots, and these branched out again into others, which may be multiplied without end by frequent culture of the alleys: for the horse-hoe has the same effect on these horizontal roots, as cutting has upon the tap-root.

2. *The method of transplanting the Lucerne.*

I Made several beds, some about three feet wide, (including the alleys,) into which I transplanted a single row of lucerne; others about three feet nine inches, into which I transplanted two rows; and others about four feet three inches wide, in which I put three rows. The design of this variation was, to see by which of these three methods the same extent of ground will produce the greatest quantity of lucerne. I believe it will require five or six years to determine exactly which
of

of them will be best; because, as the plants increase every year in bulk, their produce alters, and may perhaps not keep in proportion to the first years, though probably the difference will not be great. But without waiting so long, I can already see, that the crop will be greatest by planting only one row on each bed.

"The plants in the single rows were six inches asunder, nor should they ever be nearer; and those in the double and triple rows were eight or nine inches distant from each other. I must observe, that I likewise sowed lucerne with the drill, in beds, in which it has remained without transplanting. It is very fine; but not near so strong and flourishing as that which I transplanted. When lucerne is sown where it is to remain, it necessarily requires being thinned, and that operation takes up more time than transplanting it would do."

Rules to be observed in transplanting Lucerne into beds.

"1. **T**HE middle of the beds must be raised and arched as high as possible; and as the lucerne is to remain several years on the same ground, no pains should be spared to prepare the earth as well as can be.

"2. Lucerne should be sown in the spring, and in a rich mould, that the plants may be strong enough to transplant in September.

"3. Plants two or three years old, may be transplanted as well as younger ones.

"4. They should be transplanted in September, that they may have time to take fresh root before the winter comes on.

"5. If they cannot conveniently be transplanted in September, it may be done in October, provided the weather be not frosty.

" 6. The mould into which they are transplanted should be moist; and if the weather be somewhat rainy, it is so much the better. In this case, I have never found it necessary to water the plants.

" 7. If lucerne is transplanted in November or December, there is danger of the frosts forcing many of the plants out of the ground.

" 8. If too warm and dry a season prevents transplanting in September or October, it is best to stay till the winter is past. The plants will then be sure of taking root, and very few of them will fail.

" 9. If they can be transplanted in autumn, they will yield pretty good crops the next year: but if they are not transplanted till spring, the next year's crop will be but indifferent.

" 10. The plants must be taken up out of the nursery with great care and patience, that their roots may not be damaged.

" 11. The roots should be left about six or seven inches long, and the green tops should be cut off within about two inches of the crown of the root.

" 12. The plants will take root the sooner, if they are put into water as soon as they are taken up, and kept in it till they are planted.

" 13. They are planted in holes made with a planting stick, in the same manner as cabbages or lettuces are planted in a garden.

" 14. The best way of planting lucerne is, to cut a strait channel two or three inches deep, and set the plants in the bottom of it, covering them up to the neck.

" 15. Great care should be taken not to suffer any weeds to grow among the lucerne, at least for the two or three first years. To this end, the rows should be weeded by hand, as well as the edge of the

the alleys near the plants, where the horse-hoe cannot go.

“ 16. The alleys may be stirred, either with the single cultivator, or the cultivator with two mould boards; which, at the same time that it destroys the weeds, keep the mould loose.

“ 17. The first stirring may be given with the single cultivator, with which a furrow may be cut on each side of the main furrow in the middle of the alleys, by which means the earth will be turned over on both sides of it.

“ 18. The second stirring may be given with the cultivator with two mould boards, by drawing it along the middle of the alleys. This will turn the earth towards the rows. By these alternate stirrings, the alleys will be constantly kept in a loose state.

“ 19. This culture is so easily performed, and in so short a time, that it may be repeated frequently. In this I differ from M. Duhamel, who orders it but seldom. My opinion is, that the alley should be stirred once a month, during the whole time that the lucerne is in a growing state.

“ 20. If the alleys keep free from weeds, less stirring them may do: but the mould should never be suffered to grow too hard.

“ 21. As soon as some of the plants begin to blossom, the lucerne should be cut. It will then make excellent fodder, superior to every other kind.

“ 22. The lucerne hay should be dried as quick as possible, and frequently turned. The less it is exposed to the heat of the sun, the better fodder it makes.

“ 23. Lucerne must not be housed till it is dry: but at the same time care must be taken that it be not too dry: for then many of the leaves will fall off, as they dry sooner than the stalks.

“ 24. Cattle must not have too much lucerne given them at a time, till they are accustomed to it.

“ 25. No cattle should ever be suffered to feed on the beds of lucerne. If the earth is very dry, towards the latter end of the autumn, sheep will do it the least hurt. If the plants are then tall enough to be mowed, the best way is to cut them, and give them green to the cattle.

“ These rules contain all that is essentially necessary for making and keeping in good order this kind of artificial pasture. I can safely say, that whoever tries them, will be abundantly rewarded for his trouble and expence. Sainfoin may be cultivated in the same manner.”

Account of the produce of Lucerne planted in beds, and cultivated according to the principles of the new husbandry: with some important reflections on the advantages which may be obtained therefrom: by M. DE CHATEAUVIEUX^c.

“ **N**O judgment should be formed of what lucerne may produce, by the crops of the first or second year: it is then too young to be able to yield much. If we were to calculate even by it's third year's produce, we should still consider, that as the plants increase every year in bulk and vigour, (and where they will stop I am not able to determine,) the produce will be proportioned to that increase, and consequently the crop of each succeeding year will be greater than that of the former.

“ The crops I am going to speak of, are those of the second and third year: but my calculations will be made on that of the third year. It is pro-

per to remember, that the years 1753 and 1754 were uncommonly dry, infomuch that, sometimes, not a drop of rain, nor scarce any dew, fell between the cutting of one crop and that of another. The seasons were so unfavourable to the production of grafs, that hay rose to an excessive price.

“ I shall first say what was the state of the plants of lucerne in their third year, and afterwards how much hay they yielded.

State of the plants in their third year.

“ **A**S the part of the plant which I now consider is that which is buried in the earth, I uncovered numbers of them, that I might be able to judge of their general state. I was greatly struck with the effect which transplanting had had upon them. Instead of one perpendicular root, which they usually have, all these plants had three, four, five, and sometimes more, almost equally big roots. They were, in general, three quarters of an inch in diameter, and proceeded from the original root, which was now at least an inch in diameter, and in many of the plants an inch and a half. After the most careful search that I could possibly make, I could not find one plant of lucerne sown in the common way, though it had stood twelve, twenty, or more years, whose tap-root had grown to the bigness of an inch diameter: few of them were above half, or at most three quarters of an inch thick. This difference is very great.

“ I likewise found that the roots of the transplanted lucerne had produced another kind of roots, of which I saw none about those of the old lucerne. These were a great number of fibrous roots, some of which were already one twelfth of an inch in diameter, and looked as if they would also become principal roots.

“ The stalks seem to rise out of the earth; and from the first time of cutting them, a kind of head forms just above ground, which extends itself every year. The first year, this head was two or three inches wide: the second year, it was generally about six inches over; and this third year, almost half the plants have a crown ten or twelve inches in diameter: and as many of them have grown so as to touch one another, their crowns are become of an oval form, having extended themselves on the sides where they met with no resistance.

C R O P S.

“ **I** Have a field of lucerne in beds, divided into two parts. This is the third crop of lucerne off one of them. The beds are 250 feet long. In 1753, I cut this lucerne six times, viz. in May, June, July, August, September, and the beginning of November. This last cutting was not so plentiful as the others, and I dried it within doors.

“ These cuttings off one bed, on which there was but one row of lucerne, yielded 140 pounds of well dried hay.

“ In 1754, the lucerne was late before it began to shoot, and the earth was drier than the year before. I had but five crops: the first was cut on the 27th of May; the second, on the 1st of July; the third, on the 27th of July; the fourth, on the 26th of August; and the fifth, on the 23d of October. These five cuttings yielded in all 225 pounds of well dried hay off each bed.

“ A field 250 feet long, which was the length of my beds, and 210 feet wide, contains an arpent of our measure. This arpent, divided into 68 beds, each three feet wide, producing after the rate of 225 pounds of hay off each bed, would
yield

yield in all 15300 pounds*; which is infinitely more than is ever obtained in the common way.

“ The beds with three rows yielded much less. The third year, their crops amounted to no more than 169 pounds off each bed, which is a fourth less than the others: and as these beds are wider, instead of having 68, as in the former disposition of the arpent, there will be only 47, each four feet three inches wide, the total produce of which will be but 7943 pounds: consequently this arpent will yield little more than half as much as an arpent laid out in beds three feet wide, planted with only single rows.

REMARKS, *by* M. De CHATEAUVIEUX.

“ **T**HE plants of lucerne had the fate of all kinds of plantations: that is to say, some of them were more vigorous than others. The greatest number of the plants produced each of them a pound of dry hay, and some of them yielded two pounds. I look upon these last as such extraordinary productions, that I do not expect many of them to yield the like quantity again. I think one may be very well satisfied, if the plants, one with another, yield a pound of hay a-piece every year. This is nearly the result of my experiment on beds which had but one row; and the produce of these would have been still greater, if many of my plants had not failed: in the room of which I set young ones, which could not acquire sufficient strength to yield full crops.

“ In these experiments, I have employed no dung: neither have I for any of my corn fields. I have reserved it for improving my pastures and

* Upwards of seven loads and a half of hay, at 18 hundred weight to the load; which is equal to above six loads on an English acre.

meadows; and intend next to apply it to my lucerne, which, I doubt not, will be much the finer for it. The only thing now remaining is, to know by experience which will be the best way of using it. I have some thoughts on that head, which may render it much more profitable.

“ Lucerne deserves to be cultivated with care: not only on account of the great quantity of fodder which it yields, but likewise because the quality of it's hay is superior to any other. The new husbandry will render it still more perfect. Plants cultivated this way enjoy the benefit of a free circulation of the air, and that circulation keeps them sweet and sound, and free from all mustiness towards their roots: for, being open to the rays of the sun, that great source of kindly vegetation, they attain great perfection in all their parts, both as to their substance, and their flavour. Cattle eat this food greedily, and are better nourished with it, than with any other: but as every excess is bad, too great a quantity should not be given them at once, especially at first, lest it should swell them. The best way is, to bring them to it by degrees.

“ I have experienced these qualities in this hay, by comparing it with every other sort. The excellence of this justifies the principles on which the new husbandry is founded. I have offered to my horses bundles of every kind of hay, and at the same time a bundle of this hay of lucerne. They have not hesitated a moment to prefer the latter. Nothing but it's superior qualities could determine them in this choice, which never varied, and has always been in favour of the lucerne cultivated in this manner.

“ It would be lavishing this excellent fodder, to feed horses entirely with it. It need only be given them by turns with common hay: which will be

a great saving: for this lucerne will supply the place of oats. I am certain that my horses fed partly with this hay, and without oats, will be in better plight, stronger, and more vigorous, than those which are fed with meadow hay and corn in the usual way. It is now some time since I have fed my coach horses with it, and have retrenched their oats. Instead of this last food, and at the hours they used to have it, I gave them lucerne chopt, as the Spaniards do straw to their horses. Mine are as fond of it, and shew the same impatience to find it in their manger, as if it was oats; and since their being put under this diet, they are in better condition than before, and so mettlesome, that the coachman has enough to do to keep them in.

“ When I said that retrenching the oats would be a considerable saving, I did not so much mean the saving of the expence of that corn, as the better improving of many vast tracts of land which are sown with oats, and might, with proper management, produce much more useful and more profitable sorts of grain, notwithstanding the too general prejudice, that some lands are not capable of bearing any better. For my part, I am thoroughly satisfied, that whatever ground can bear a crop of oats, can likewise, under the new husbandry, bear any other grain.”

Continuation of M. DE CHATEAUVIEUX's account of his experiments on Lucerne, in the years 1755, and 1756 ^d,

“ **T**HE great drought of the year 1755 was accompanied with great heat; and the year 1756 was very rainy, and moderately warm, there being but few very hot days in it.

^d DUHANEL, *Culture des Terres*, Tom. V. c. 5. ART. 5.

“ My

“ My lucerne was exposed to a most severe winter in 1755, when the frost was excessive hard, and lasted very long. M. de Reaumur’s thermometer was some days, at different times, 8, 9, 10, 12, and 13 degrees below the freezing point; and on the 3d of February, a thermometer in the open air, stood at 16 degrees* below freezing. These severe frosts made me uneasy for my lucerne, which, however, bore them without receiving any damage.

“ The rains in 1756 did no hurt to these plants, but they prevented my cutting them at proper times. I had but four crops of lucerne this year, being obliged to wait for an appearance of fine weather to dry it in, before I could venture to cut it down. These rains likewise hindered my giving the proper hoeings to the alleys, which were full of weeds during the summer and autumn. I chose rather to leave them in that condition, than attempt to hoe them while the ground was over wet: not doubting but the spring hoeings would easily destroy them.

“ In 1755, I cut my lucerne five times: the first was, on the 3d of May, before any flowers appeared: the second, on the 12th of June: the third, on the 15th of July: the fourth, on the 21st of August; and the fifth on the 7th of October. I was obliged to finish the drying of this last cutting, in barns and under cover.

* The greatest cold in the winter of the year 1799-40, sunk Fahrenheit’s thermometer to about 12 degrees, equal to 11 degrees below the freezing point of M. de Reaumur’s thermometer. The 16th degree below the freezing point of M. de Reaumur’s thermometer, answers to nearly the 3d degree of Fahrenheit’s: consequently the cold was, by Fahrenheit’s thermometer, 9 degrees greater in Switzerland in 1755, than it was here in the severest frost of the very hard winter in 1799-40: and therefore, as M. de Chateaufieux’s lucerne was not hurt by that intense cold, there can be no fear of this plant’s being killed by any inclemency of the weather in this country.

“ In

" In 1756, which was the fifth year of these plants, I cut them but four times: the first, on the 3d of June; the second, on the first of July; the third, on the 4th of August; and the fourth, on the 27th of September.

A bed 250 feet long, with only one row of lucerne,

Yielded	{	In 1754	225	} pounds of dry hay.
		1755	.	.	.	.	197
		1756	.	.	.	.	281

In three years, 703 pounds.

A bed of the same length, with three rows of lucerne,

Yielded	{	In 1754	169	} pounds of dry hay.
		1755	.	.	.	.	180
		1756	.	.	.	.	226

In three years, 575 pounds.

O B S E R V A T I O N S :

by M. DE CHATEAUVIEUX.

" **W**E see, by the above account of three years, that a piece of ground laid out in narrow beds, planted with only one row of lucerne, yielded a greater produce than the same extent made into wider beds, and planted with three rows.

" I shall not, however, pretend to determine from this one experiment, that it is best to lay down large fields in this manner. I think it will be right to try first, whether the success will be the same on different soils, and likewise on
lands

lands whose exposition may be more or less advantageous. If, after repeated trials, the beds which have but one row of plants, yield the greatest quantity of hay, that method is certainly to be preferred. To clear up this point still more to my satisfaction, I continue to plant lucerne in beds, some with one, and others with three rows.

“ The difference between the crop of 1756, and those of the two preceding years, would induce one to think that rainy seasons are best for the production of hay: but still, the greater quantity which the year 1756 produced, must not be imputed to the rain only; we should likewise consider, that the plants had throve greatly since 1754; that their stems were grown much larger, and their roots much stronger and more numerous, and that they were consequently able to yield much greater crops than before. They have abundantly answered my expectation, both as to quantity and quality.

“ With respect to the quantity, it is much greater than that of any common fodder: I mean, of any that the same extent of ground would have produced, if cultivated in the common way, though it would then have been covered with an immense quantity of plants. This is a fact, which numbers of experiments prove, and which we shall cease to wonder at when we consider the great effects of the frequent stirring of the alleys. To this it is that I owe the repetition of my crops, and their being all of nearly equal goodness. I do not exaggerate when I say, that every summer month, which is the time I generally allow between each cutting, will produce shoots two feet long, and sometimes more: and supposing that I cut them but five times a year, each plant will have produced after the rate of nine or ten feet length of shoots, and
that

that in the same time that most meadows will not produce grass above two feet long.

"As to the quality of this hay, I continue to prefer it to all other fodder. My experience has confirmed what I said of it in 1754; and I shall only add, that I have since found, that it is as good at the end of four years, as when it is first cut. If there was any difference, horses would soon be sensible of it, but they eat of either without distinction.

"I feed my horses with it, chiefly in the summer, at which time they do most work, and are more and more sensible of the advantages of it. Five or six pounds of lucerne a day are sufficient for a middle sized horse: but the quantity may be increased or diminished, according as the horse is nourished by it; for in that there is great difference."

Experiments on the culture of Lucerne, communicated to Mefs. de Chateaufieux and Duhamel; with an experiment made by M. Duhamel.

IN April 1753, M. Diancourt sowed lucerne in rows, of which many plants produced an ounce of hay a-piece in September following. In June 1754, the same plants yielded 12 ounces and a half each. He reckoned that, one with another, each plant had afforded him a pound of hay, which is a very great crop. On an arpent sown in double rows, he had 26400 plants*: and on another sown in single rows, 15400†: but whether the plants in the single rows were so much

* A pound of dry hay from each of these plants, would amount to upwards of 13 loads of hay; equal to ten loads and a half on an English acre.

† At the same rate, these would produce about 7 loads and a half, at 18 hundred weight to the load.

larger

larger and more vigorous, as to compensate for the greater number in the double rows, was what he could not determine at the time of his communicating this^a.

M. de Pontbriant, of Rennes in Britany, rightly judging that one of the most essential services he could render to his country, would be the improving of the pasture of that province, which is famous for the production of cattle; planted lucerne, to shew the people how small a space of ground, and that too cultivated by the very cattle which are fed upon it, will produce a greater quantity of much better fodder, than all the grass which their vast commons and extensive pastures yield them^b.

In September 1755, he transplanted lucerne from a field which was to be fallowed. The roots of the plants were three or four feet long. He planted them in beds six feet distant, and the plants eight or ten inches asunder, in a field which he thought free from weeds. In this he was mistaken: for, though the lucerne made very good shoots, yet, by neglecting to hoe the alleys, weeds came up and over-run the ground.

He mowed the whole, then horse-hoed it, and planted a new row of lucerne between each of the former rows; and he expects that next year will yield him several good crops; which M. Duhamel thinks he may depend on, if he can but get the better of the weeds.

A gentleman at Montelimart in Dauphiny, writes as follows to M. de Chateauneux^c.

“ In the autumn, I transplanted from a spot of lucerne three years old, as many plants as were

^a DUHAMEL, *Culture des Terres*, Tom. IV. c. 1. ART. 3.

^b *Ibid.* Tom. V. c. 1. ART. 15.

^c DUHAMEL, *Culture des Terres*, Tom. V. p. 531.

“ requisite

“ requisite for a space 96 yards square, made into
 “ beds. The middle of the beds was raised very
 “ high, and I planted only a single row in each.
 “ The first cutting yielding me one truss of hay:
 “ the second, four: the third, six. The shoots
 “ of the last cutting were pretty tall, and seemed
 “ to be deficient only in number: that, without
 “ doubt, will come by and by, when the roots
 “ shall have multiplied and grown stronger. I hope
 “ that the heat of this climate will not stop their
 “ growth: for I take care to stir the alleys as often
 “ as the lucerne is cut.

“ A little later in the season, I planted 440
 “ yards more with lucerne, which I watered, be-
 “ cause the weather was cold and dry. The plants
 “ succeeded very well, excepting a few which
 “ died. The first cutting was very weak; the se-
 “ cond, middling; and the third is now growing,
 “ it being but 17 days since the last was cut.
 “ Several of the shoots are already 18 inches long.
 “ I have not yet dunged any of these beds: but I
 “ intend to dung them all next winter, in order
 “ to quicken the growth of the plants, and give
 “ them greater strength.”

The same gentleman writes again to M. de Cha-
 teauvieux, on the 12th of September 1755, to the
 following effect^b.

“ I have already cut my lucerne in the new way,
 “ five times, and hope to have a sixth cutting
 “ towards the end of this month. As the drought
 “ does not cripple my plants, but only retards
 “ their growth for about a week, I cut them at the
 “ end of 25 days, when they were in full bloom:
 “ whereas, in this season, they require at least a
 “ month. The stalks are full as strong, and the leaves
 “ as large, as those of other lucerne which is well

^b *Ibid.* p. 532.

“ dunged,

“dunged, and plentifully watered every fortnight.
 “The only inconvenience I find, and that not a
 “great one, is, that this lucerne is difficult to
 “mow*, because the stacks do not stand to the
 “scythe, and many of them trail upon the ground.
 “This year I have used a sickle; but it does not
 “dispatch the work so quickly as a scythe. Per-
 “haps stirring of the alleys with the cultivator
 “and plough, (neither of which I have used this
 “year,) to clear the ground of weeds and loosen
 “the mould, may help to strengthen the stalks;
 “and as they grow thicker every year, they will
 “be better able to bear the scythe. I have pre-
 “pared a great deal more ground, to enlarge my
 “plantations of lucerne. The drought stops me
 “for the present; but as soon as the rains shall
 “have moistened the earth, I intend immediately
 “to plant a surface of at least one acre.”

The following letter to M. de Chateaufvieux, is dated from Chateau Gaillard in the Upper Bugey, near Lyons, June 6, 1755^c.

“Lucerne which I sowed last March, observing
 “your directions in the culture of it, is now two
 “feet high; which plainly shews me, that I shall
 “be able to cut it six times next year. Some of
 “my neighbours have sown lucerne mixed with
 “oats, in a better soil than mine, but without
 “horse-hoeing it, or stirring the ground between
 “the plants. It is now but two inches high, and

* This inconvenience, says M. de Chateaufvieux, is but a small hindrance. I mow my lucerne, and it stands the scythe very well, especially the second year. A few trailing stalks which may escape the scythe, are of little consequence; and expert workmen will leave but few, even of them. I have a plantation of lucerne which is always cut with a sickle; though it would very well bear the scythe. This I do, than, by losing none, I may be able to judge the more exactly of it's produce.

^c *Ibid.* p. 536.

“ is

"is in danger of being destroyed by the drought, which mine is not."

A letter from the same, dated July the 5th, 1755, says a.

"On the 20th of June, I cut my lucerne which was sown in March. It was three feet high when I cut it, and has already made fresh shoots thirteen or fourteen inches long. I have let some of it stand, which will produce good feed. This will afford me an opportunity of convincing the most incredulous, of the superior excellence of the new husbandry."

This lucerne, after having been cut a second time, was two feet high on the 17th of August: while that sown in the old way, and mixed with oats, had not been cut at all, and was but four inches high.

M. Duhamel himself^e, in the autumn of 1755, took up the roots of an old field of lucerne, which were about the thickness of a man's thumb, and six or seven inches long, and replanted them in trenches. All his husbandmen told him that they were worn out, and too old to shoot again: but yet not one of them failed. They yielded three cuttings the first year, though the soil was by no means proper for them. As there still remained some rows which could not be transplanted in the autumn, he removed them the next spring. Many of these plants perished; and the shoots of those which took, were much shorter than those of what had been transplanted in the autumn. To replenish the empty spaces, he laid down some slips of the neighbouring plants, by which means he hoped those chasms would be filled up the next year.

This is a very simple and easy way to renew old pastures of lucerne, and to have constant crops of

^a *Ibid.* p. 438. ^e *Ibid.* p. 3.

this excellent fodder. Great care is requisite, both in taking up the roots, and in planting them again.

An English Turbilly is conspicuous in the foregoing experiments on the culture of sainfoin in Yorkshire; and another, of equal rank and title (much I regret the want of leave to publish the names of such illustrious correspondents), animated with the same noble zeal for the universal welfare of mankind, has honoured me with a letter from Lincolnshire, dated the 3d of January of the present year 1763, in which he desires to add the two following cautions, founded on his own experience, to M. de Chateaufieux's directions for planting lucerne, whenever that method is practised in this country.

“ One is, always to plant it in good time, that
 “ is to say, somewhat earlier than M. de Chateaufieux directs: the other, not to plant it on a
 “ ridge; or, if you do, to make a deep trench on
 “ the ridge, and, having buried your plants to
 “ the neck, to leave a ridge on each side of them,
 “ somewhat like what is done in the planting of
 “ celery, in order that the mould may be drawn
 “ to them when rain has saddened the earth, and
 “ left perhaps an inch of the neck bare; because,
 “ for want of this, the first hard frost may throw
 “ them out of the ground, as happened to two
 “ whole acres of my planting, in the year 1761.
 “ I took all the precautions advised by M. Duhamel, but planted my lucerne on ridges, or
 “ little lands, three feet wide. The soil was in
 “ good order; having been very well plowed and
 “ manured, and being naturally light. Heavy
 “ rains, which fell before Christmas, washed a
 “ great part of the light earth down into the
 “ furrows; and in the spring of 1762, repeated
 “ snows

“ snows and frosts loosened the ground to such a degree, that the whole crop was thrown out of it.

“ This year (1763), I have a better prospect; owing, I think, to my having made use of the above precautions. The wet has washed the little ridges down to the plants, and I hope they will not be hurt by the frosts: though, when the season will permit, I shall have all the roots earthed up and trodden*.

“ Last summer was the second year of a quantity of lucerne that was sown on a light poorish soil, in drills three feet distant from each other: yet, though the season was very dry, and remarkably bad for all sorts of grafs, I cut it four times, and the stalks were, at each cutting,

* My letter to this distinguished patriot, requesting to be informed of the farther success of these plants, seems, unfortunately, not to have reached him; for I cannot impute to any other cause, the silence of a gentleman whose noble spirit induced him to communicate these judicious remarks, purely for the public good, and who was, most obligingly, pleased to promise me his observations on other interesting parts of the husbandry practiced in Lincolnshire. I therefore take this method of returning my sincere thanks for the favour already conferred; and hope that the public, whose welfare he has so evidently at heart, will not continue to be deprived of his excellent instructions. Happy shall I esteem myself in being the channel through which my country may be benefited! and I cannot but indulge the pleasing expectation, that the truly intelligent, the wishers of the real happiness of mankind, will, animated by the fine examples now set before them, think it the duty of an Englishman to contribute to the permanent glory of this happy kingdom, by imparting to the world such improvements in any of the various branches of husbandry, as have come to their knowledge: for, it cannot be too often repeated, agriculture is the source, and solid foundation, of the prosperity of nations. Our rival neighbours are so sensible of this important truth, that even their nobility take a laudable pride in prefixing their names to experiments in husbandry, and in being real patrons of this art. Let us then, here learn from them. *Fas est et ab hoste doceri.*

“ except the last, from eighteen inches, to two feet long.

“ I found my horses very fond of it, though not so much as to prefer it to all other sorts of food. Trefoil, for instance, seemed to please them as well; and they could eat much more of it: for they are quickly stalled with the lucerne, though, after resting half an hour, they fall too again very greedily.

“ I have sown some lucerne in Mr. Rocque’s method. It promises fair, but has not been cut, being sown only last April. I am convinced that it will not be killed, or even much damaged, by being well harrowed, or even plowed: for some chance roots, which grew in the intervals between my rows of drilled lucerne, were hoed over with the horse-hoe many times last summer, were often laid bare six inches deep, and yet have been so far from being destroyed, that they have constantly had flourishing tops. If the weeds can be kept from growing so as to do much harm, by this method, I am satisfied that it will be the best: horse-hoeing being a considerable trouble, and so much out of the common way, as not to be likely ever to become general.”

Excepting some parts of what has already been said, M. Duhamel’s Elements of Agriculture contain little more than the following heads relative to the culture of this very useful plant.

He thinks^f it will be right to dung the lucerne the third year after it has been planted; never to overflow it, where that can be done, unless the season be excessively dry, and even then to let in the water very sparingly, and for a very short time only; and not to let any cattle feed upon the

^f *Eléments d’Agriculture, Tom. II. Liv. 9. c. 2, Art. 1.*
plants

plants where they grow, if it be intended that they should last long. He observes that, if it be much wet in the field after it has been mowed, it's leaves will turn as white as paper in a few days; but that, if it be only a flying shower, which has penetrated no farther than the surface, the best way is not to touch the swarths till the wind has dried them. In very hot weather, this hay must be housed before it is quite dry; or the greatest part of it's leaves will fall off, and be lost. He is clearly of opinion, that it cannot be kept long in stacks, in the open air, unless those stacks are thatched very thick, with good straw, to turn off all wet: and after mentioning the practice of some farmers in France, who, if they stack their lucerne before it is thoroughly dry, leave a hole down through the middle of the stack, as will hereafter be directed for hay, to prevent it's heating; he adds, as a much better method, that of others, who, when obliged to house this hay earlier than they would wish, lay it and straw in alternate layers, in their barns. The straw, thus placed, preserves the lucerne from heating, and contracts a fine sweet smell, so pleasing to horses, that they eat it with appetite when given to them in the winter, mixed with the lucerne.

M. Duhamel assures us, from his own experience, that this fodder, cut before it had blossomed, and given green, has restored young horses which had fallen away and lost their flesh, when no cause could be assigned for their decay; and that cows fed with it, yield an extraordinary quantity of excellent milk. He holds it to be most excellent food for every kind of cattle, horses, oxen, cows, sheep, all of which are fond of it, either green or dry. It's only fault, says he, is, that it is too nourishing when dry, and that cattle, if let alone, will then eat of it till they swell and

burst themselves. But this is easily prevented by stinting them to a proper allowance, with which they will hardly ever fail to fatten and grow strong.

M. Duhamel concludes this article with observing, that, in some years, swarms of black caterpillars are apt to breed in the lucerne, and to eat up all it's young shoots; to prevent which mischief, he rightly advises cutting it down as soon as those enemies begin to appear; because they will thereby be destroyed, and the plants will soon shoot out anew; generally without any damage to the ensuing crop.

A R T I C L E III.

OF THE CYTISUS.

WHETHER this plant, which was highly esteemed by the antient Romans, ought, by us, to be looked upon as a shrub-trefoil, or a shrub-lucerne; or, whether we should call it, as Tournefort does, *Medicago trifolia*, *frutescens*, *incana*, shrubby, hoary, three leaved *medicago*, and accordingly, with Mr. Miller^a, class it as a species of medic; belongs to botanists to determine, and not to this work. Mr. Miller, who has taken some pains to discuss this question, is satisfied that the *Cytisus* of Virgil, Columella, and all the old writers on husbandry, in this *medic*, to which he allows every quality that can recommend it for the feeding of cattle in the countries where it grows naturally, such as the islands of Archeipelago, Sicily, and the warmest parts of Italy; but is persuaded that it will not thrive in England, so as to be of any real advantage for that purpose here; be-

^a *Gardener's Dict.* Art. MEDICA.

cause it cannot bear such hard frosts as we sometimes have, or, if it does bear them so far as not to be absolutely killed, it will be so much damaged thereby, as not to be able to recover it's verdure before the middle or latter end of May; nor even then to put forth shoots that will bear cutting more than once in a summer; besides their being so woody, if suffered to grow to any considerable length, as to render that cutting very troublesome, and of little service by way of fodder. He therefore thinks that, upon the whole, it can never answer the trouble and expence of cultivation in this country, where we have very many other preferable plants; but that, in hot dry rocky countries, of which we now have several in our colonies, where few other vegetables will thrive, (and therefore it is, chiefly, that I mention it here), this may be cultivated to great advantage; for it will live there many years, and prosper well.

Columella^b and Pliny^c were, however, of a different opinion from Mr. Miller, in regard to the hardiness of this plant, which, say they, will not only thrive in the very poorest soil, but will likewise endure almost all injuries; among which they could not but mean frost, as it is well known that most parts of Italy, notwithstanding their heat in the middle of the day, and the same holds good with respect to other countries familiar in that respect, are liable to very keen frosts, which come on suddenly, and are, for that very reason, far more dangerous to all sorts of vegetables, than those which, though much more intense, and of far longer duration, come on more gradually. I therefore cannot but incline to think, that Mr. Miller may be mistaken here.

^b *De Re rustica*, Lib. V. c. 12.

^c *Natural. Hist.* Lib. XIII. c. 24.

This plant rises to the height of five, six, or even more, feet, with a shrubby stalk covered with a grayish bark, and divided into many branches, covered with a hoary down while they are young, and garnished at each joint with trifoliate leaves standing upon footstalks about an inch long. There are two or three of these at each joint, so that the branches are closely covered with them. The lobes are small, spear-shaped, and hoary on their under side, and these leaves remain all the year. The flowers, which are of a bright yellow, blow on footstalks which arise from the side of the branches, each footstalk sustaining four or five flowers; and these are succeeded by compressed moon-shaped pods, each containing three or four kidney shaped seeds.

The *Cytisus* may be raised either from it's seed sown about the middle of October, or in the beginning of April, or, if greater speed be desired, from cuttings, slips or layers, planted in the spring or autumn, so as to leave a space of four feet between every plant. Such are the directions of Columella, who adds, that if the ground be well dunged for this planting, and hoed up around the plants, which should be watered during the first fortnight, if rain doth not fall, plentiful crops may be obtained of this excellent vegetable, equally fit for horses, oxen, cows, sheep, hogs, goats, and poultry, and singularly profitable for bees, whose honey it increases prodigiously. It has the same effect on the milk of cows, besides greatly improving it's quality. In the kingdom of Naples, the goats feed upon it, and great quantities of excellent cheese are made of their milk. In the islands of the Archipelago, the Turks make handles for their sabres of the wood of this shrub, which, when full grown, is as hard as ebony, and of a fine yellow colour. It will bear cutting as often as
it's

it's shoots are about fifteen or eighteen inches long, which may be several times in the year; for it shoots and flowers during eight months in countries where it grows well, and continues green during the whole winter, if that season be at all favourable. It's seeds begin to ripen towards the end of August, and continue so to do till the cold stops them. It will be fit for cutting at the end of three years at farthest, and should be carefully kept clear of weeds, and hoed up between each cutting. If given as green fodder, which it affords during eight months of the year, as before said, about fifteen pounds weight of it are enough for the daily food of a horse, twenty pounds for an ox, and so in proportion for other cattle, according to their size and strength. When made into hay, it should be given more sparingly, because it is then more nourishing. In this state, it should be steeped in water before it is given to cattle, and then be mixed with chaff or straw. The time of cutting it for hay, is when the greatest part of it's seeds begin to grow big; and the manner of making this hay is, to let the swarths lie some hours in the sun, till they are faded, and then to dry them thoroughly in the shade^d.

A R T I C L E IV.

OF BURNET.

THE public owes the improved culture of this plant, the *Pimpinella* of Linnæus, the *Tragoselinum* of Tournefort, the *Pimprenelle*, or *Bou-cage*, of the French, and a native of our country, which promises very great advantages, to the laudable pursuits of the Society for the Encourage-

^d COLUMELLA, *ubi supra*.

ment of Arts, Manufactures, and Commerce, in quest of a green and succulent food for cattle during the winter months: but more immediately to the judicious observation of Mr. Rocque, already mentioned, who, remarking that Burnet retains it's verdure amidst the inclemencies of that season, resolved to try the effect of giving it a good culture. He has succeeded therein to his utmost wish; and I may congratulate him on the immortality of his name, wherever this useful plant shall be duly attended to. Three years have not yet enabled him to publish to the world an account of the best method of treating it, vouched by proper experiments: but he intends to do this as soon as he shall be sufficiently informed. It bids fair to be of singular utility where flocks of sheep are kept, because, as it preserves all it's leaves unhurt by frost, the farmer may thereby have a constant stock of green food for his ewes and lambs, at a time when turneps and every other succulent plant may fail him. On this account, I would strongly recommend the culture of this healthy ever-green, particularly to all such farmers: for that it, probably, will stand the rigour of the sharpest winter, appears plainly from it's not having been sensibly impaired in any respect by the severe and long continued frost in December and January last.

In describing this plant, Mr. Miller distinguishes ^s seven different species of it; but only three, or perhaps rather but two, of them seem to be the sorts proper to be cultivated for the food of cattle. These are 1. The *Tragofelinum majus*, *umbellâ candidâ*^h, Greater burnet saxifrage with a white umble; 2. *Tragofelinum alterum majus*ⁱ,

^s Gardener's Dict. Art. PIMPINELLA.

^h TOURNEFORT, *Inst. R. H.* 309 ⁱ *Id. ibid.*

another

another greater *burnet* saxifrage; and 3. The *Tragopogon minus*^k, or lesser *burnet* saxifrage. All these are equally hardy plants, and natives of this island: but the largest sorts promise the greatest quantity of fodder, and therefore should, probably, be preferred by the husbandman. A fourth sort, which Mr. Miller mentions by the title of *Tragopogon radice nigra Germanicum*^l, German *burnet* saxifrage with a black root, will probably answer as well in it's native country, Germany, as our's will here; and I therefore recommend the trying of it there; as I do to other countries, the cultivating of their native species of this plant, in full confidence that they will find it answer greatly for the winter green food of their cattle. Experience has proved that all countries are benefited by the introduction of foreign plants, as particularly the lucerne, sainfoin, &c. I therefore take this opportunity of recommending a trial of the German *burnet* here, and of our's in Germany and elsewhere.

The first of the above-mentioned species of *burnet* grows naturally in woods, and on the side of banks near hedges, in several parts of England. The lower leaves of this sort are winged, and composed of three pair of heart-shaped lobes, terminated by an odd one: they are sharply sawed on their edges, and sit close to the mid-rib. The lower lobes, which are the largest, are near two inches long, and one and a half broad at their base, and are of a dark green. The stalks grow more than a foot high, dividing into four or five branches; the lower part of the stalk is garnished with winged leaves, shaped like those at the bottom, but smaller; those upon the branches are short and trifid; and the branches are terminated

^k *Id. ibid.* ^l JUSSIEU. HORT. CHELSE. CAT. 100.

by small umbels of white flowers, which are composed of smaller umbels or rays. The flowers have five heart-shaped petals which turn inward and are succeeded by two narrow, oblong, channelled seeds. It flowers in July, and the seeds ripen in autumn. A variety of this, with red flowers, is frequently found among the other, and rises from the same seed.

The second sort grows naturally in dry pastures in many parts of this Island. The lower leaves of this are composed of four pair of lobes, terminated by an odd one: these are roundish: those on the lower part of the leaf are about half an inch long, and the same in breadth: they are indented on their edges. The stalks rise near a foot high, and send out three or four slender branches, which are garnished with very narrow leaves. The umbels of the flowers of this are smaller than those of the former sort, as are also the flowers and seeds, which blow, and ripen, about the same time.

The third, or smaller, sort of burnet grows naturally in dry gravelly pastures in several parts of this country. It's lower leaves have five or six pair of lobes terminated by an odd one, and are deeply cut almost to their mid-rib, in form of wings. The stalks are slender, and rise about a foot high, sending out a few branches which have a narrow trifid leaf placed at each joint, and are terminated by small umbels of white flowers composed of several rays standing upon pretty long foot-stalks. The flowers of this sort appear, and it's seeds ripen, at the same time as those of the former; but they are smaller.

That I may go through the useful part of Mr. Miller's description of the several species of this plant, I must here mention, because the culture of it may possibly turn to advantage in some of our

our warm colonies, Linnæus's *Pimpinella foliis radicalibus trifidis incisiss^m*, Pimpinell with trifid cut lower leaves, which is the *Anisum vulgareⁿ*, or common Anise. This is an annual plant, which grows naturally in Egypt, but is cultivated in Malta and Spain, from which countries it's seeds are brought annually to England, where a water is distilled, and an oil drawn, from them, for medicinal uses. Our pastry-cooks and confectioners also make great use of these seeds in several of their compositions, to give them an aromatic taste and swell. The lower leaves of this sort are divided into three lobes which are deeply cut on their edges. It's stalks rise about a foot and a half high, and divide into several slender branches, which are garnished with narrow leaves cut into three or four narrow segments, and are terminated by pretty large loose umbels, composed of many smaller umbels or rays, which stand on pretty long foot-stalks. The flowers of this species, which are small and of a yellowish white, appear in July, and are succeeded by oblong seeds, which ripen in autumn, even here, if the season prove warm. The time for sowing them is the beginning of April; and the place, a warm border of fine mould where the plants are to remain. Thinning them after they are come up, and keeping them clear of weeds, are the only culture which this plant requires: but it is too tender to be cultivated in England, for profit.

I therefore return to the far more useful, and consequently more valuable, sort of burnet, namely, the larger species concerning which the following are the chief directions which Mr. Rocque's experience has hitherto enabled him to give. The obliging readiness with which these have

ⁿ *Sp. Plant.* 264;

ⁿ *CLUS. Hist.* 2. p. 302.

been

been communicated, for they never before appeared in print, entitles the author of them to my particular thanks, and shews him to be happily possessed of that laudable spirit, which disdains all selfish views, when the welfare of the public is concerned.

In the meadows about Windsor, half the grass is burnet. M. Rocque has experienced, that it will grow in the driest land: for he has planted some of it even in the gravel walks in his garden, where every thing else is burnt up in the summer; but this never withers: one of the qualities of burnet being to continue in sap all the year. It is the opinion of many who have seen the burnet of his raising, that if this plant is generally cultivated, there will never be a scarcity of hay in England, even in the greatest drought.

The land on which it is sown should be in fine tilth, and free from weeds, especially couch-grass, which is here the most hurtful of all. A drag, that is to say, such a fork as the gardeners clean their asparagus with, is the best instrument for extirpating this weed. The dragging of an acre thus will cost six or seven shillings. If the land is poor, it should be dunged, and laid down very smooth. The seed may be covered with a very light harrow, for it will not bear to be buried deep, and the ground should then be rolled, that it may be smooth for mowing. It may be sown at any time between April and September.

A thought occurs to me here, which I mention, though it is hitherto unsupported by facts.—If the seeds of plants which do not arrive at their perfection in a few months, or during the first year, such as lucerne, sainfoin, and burnet, are sown in the spring, or beginning of summer, and the weather prove dry, or cold; the young plants are often crippled or destroyed: but if they are
sown

sown in the latter end of July, or beginning of August; the rains frequent at that season, the heavy dews which fall, and the increasing coolness of the nights, often bring them as forward by the latter end of November, as those sown in April. Or M. de Chateaufvieux's practice of having a nursery, from whence these plants may be transplanted in August or September, may be the most secure and successful method of cultivating them; because they can then be set at whatever distance is thought most proper, and may by that means be most easily preserved from weeds, by hoeing, or otherwise. Indeed the quick and bushy growth of burnet, by which it soon covers all the ground, is, of itself, an almost effectual bar to weeds.

Though Mr. Miller does not assign this reason, yet his directions for sowing many seeds in August, rather than in the spring, are an indication, that this practice is founded in reason. Mr. Rocque's advice, to prefer July or August for the sowing of burnet, shews that he also had observed the advantages of sowing at this season.

Ten pounds of burnet seed may do for an acre of land: but twelve, fourteen, or even sixteen, pounds will be better; because, when burnet is thin, the plants grow so large, that the hay made of them is coarse. These will rise in eight or nine days after the sowing. If great numbers of weeds come up with them, it will be less chargeable to let those weeds grow with the burnet, till it is about five or six inches high, than to weed or hoe it. The whole may then be mowed, and gathered clean off; and the quick growth of the burnet afterwards will choak all other weeds. The heart of the burnet being almost within the ground, the scythe cannot hurt it.

If the burnet does not grow equally every where, some plants must be drawn where they are too thick,

thick, and planted where they are thinneſt: or the vacant ſpaces may be ſupplied from the nurſery before mentioned. If the land was not got in good order to ſow the ſeeds at a proper ſeaſon, the burnet may be tranſplanted at Michaelmas from this nurſery, and ſet at nine or twelve inches diſtance every way, according to the richneſs of the ſoil.

The ſeed ſown in May may be mowed at the latter end of July. That ſown in June will yield a pretty good crop, and muſt be cut but once; and the ſame of that which is ſown in July. The plants produced by the ſeeds ſown in Auguſt ſhould be mowed, to deſtroy the weeds. Theſe mowings may either be given green to horſes, or be made into hay. The firſt ſpring cutting will purge horſes; and Mr. Rocque believes it will alſo cure the greaſe: but it is only the firſt crop that purges.

Burnet ſhould be mowed but once the firſt year, in order to leave it rank in the winter; and in this caſe it will be ready to feed in February or March, or to mow again in April.

If natural graſs grows among the burnet, it may be harrowed in the ſame manner as lucerne; for, having a tap-root, the harrow will not hurt it: but it muſt not be plowed, leſt the roots ſhould be broken in the ground.

When the ſeeds of this plant are to be ſaved, it muſt neither be fed, nor mowed, in the ſpring. The ſeed will be ripe about the middle of June, when it muſt be reaped, like wheat, and thrashed on a cloth. It ſhould be thrashed before it is too dry, becauſe it is apt to ſhed, and it ſhould afterwards be dried perfectly.

Burnet does not loſe it's leaves in drying; and though the hay made of it be ſticky, it will, after thrashing, be very agreeable to horſes, which are ſo fond of it, that they never waſte any. One acre will produce upwards of three loads of hay, and
above

above forty bushels of seeds. Horses are fonder of this seed, than they are of oats: and Mr. Rocque is of opinion that it is a more proper food for those that do not labour hard, because it is not of so hot a nature. Burnet bears seed twice a year, and will afterwards yield a very good spring crop.

It is not only good for horses, but also for all manner of cattle; even for swine: and Mr. Rocque has experienced another virtue in it, which is, that, being stung by a wasp, the leaves of this plant rubbed pretty hard upon the part so injured, immediately took off the inflammation.

Mr. Worlidge mentions ^a as another excellent quality of this plant, that all good house-wives hold, as an infallible rule, that there never need be bad cheese or butter, but especially cheese, where saxifrage grows: "from whence, adds he, "it cometh, that the Netherlands abound much "in that commodity, and only, as is supposed, "through the plenty of this herb."

Mr. Rocque's burnet, from the squareness of its seeds, seems to me to be the *Pimpinella sanguisorba* of Mr. Ray, who distinguishes two species of this plant, viz. the *Pimpinella minor hirsuta*, small hairy burnet, which I take to be the first species of Mr. Miller's *Poterium*; and the *Pimpinella sylvestris major sanguisorba*, great burnet, which is Mr. Miller's first species of the *Sanguisorba*. The small oblong seeds of burnet are those of Mr. Miller's first species of the *Pimpinella saxifraga*, which is Tournefort's *Tragopogon majus*. Mr. Ray observes, that the first of these sorts grows naturally in dry chalky pastures, and the latter in wet meadows. He likewise describes a large species of burnet, which is a native of America, and which resembles our's in every respect.

^a *Systema Agriculturae*, p. 32.

^b *Hist. Plant. Tom. I. Lib. 9. c. 11.*

C H A P. III.

COMPARISON OF THE OLD HUSBANDRY
AND THE NEW.

IT is now that, having treated fully of the culture of the several sorts of plants which either are, or may be, profitably raised in the field, for the food of men, or cattle, or which may be benefited by horse-hoeing, though perennial; we may, with propriety, take a comparative view of the old husbandry and the new. As this is an object of the greatest importance, not only to the husbandman, as an individual, but to the nation in general; I hope to be excused, if I recapitulate some parts of what has been already said.

Many gentlemen, in this kingdom, have raised wheat in drills, horse-hoeing the alleys; and, where due care has been taken, generally with success. The grain has, in almost all instances, been larger and better than that in the broad cast way, and seldom less in quantity. Sometimes it has been much more; as Mr. Miller notices very remarkably, when he assures us of his being informed by persons of great credit, that even twelve quarters of wheat have been reaped from an acre of land drilled and managed with the horse-hoe. —But this is such a crop, as I shall not attempt to reason upon. He is more within the bounds of moderation when he says^b, that he himself has known eight or ten quarters reaped from an acre, over the whole field, and sometimes more: though I shall not form my calculations even from these extraordinary crops.

^a *Gardener's Dict.* Art. TRITICUM.

^b *Ibid.*

I am sorry to observe, that, though I have been honoured with many letters in commendation of the plan of this work, and, if I might be allowed to say it without the imputation of too much vanity, even not disapproving of the execution of what has hitherto been published; only those three of my countrymen, whose experiments on sainfoin and lucerne I have given in the preceding chapter, have, as yet, suffered their love of the public weal to prevail so far as to induce them to impart any accounts of their improvements in husbandry.—To what shall I impute this alarming deviation from those sentiments which used gloriously to distinguish the British nation? from those sentiments which animated a Bacon, a Hartlib, a Platt, a Worlidge, an Evelyn? Illustrious men! immortalized by the services thereby rendered to their country.—Is it, that few among us now attend to the study of agriculture?—Has our unbounded commerce, and the vast opulence accruing therefrom, unfortunately rendered the English less attentive than they were, and ever ought to be, to this most genuine, and inexhaustible, source of their prosperity?—Have the extraordinary ease and affluence of the present inhabitants of this island, unhappily contributed to render them less sensible than heretofore, to the general duties of Society?—Far different is the case of those admirable lovers of their native land, the free and brave inhabitants of Swisserland, whose affection for their dear country, as they constantly call it, shines in every page of the very useful Memoirs of their laudible Society at Berne.

It is judiciously remarked by the gentleman who favoured me with the foregoing account of his culture of sainfoin in Yorkshire, that “ M. de Chateauvieux’s experiments are very exact, and “ seemingly conclusive: but that, besides their

“ being made in a climate very different from
 “ our’s*, the great superiority which the new hus-
 “ bandry, as it is called, appears to them to have
 “ over the old, may, and probably is, in some
 “ measure, owing to the bad manner of farming
 “ which prevails generally in his country: for
 “ that, according to his own account, their lands
 “ lie fallow every third year, and they sow too
 “ great a quantity of seed: whereas, if the just
 “ proportion were observed, according to the na-
 “ ture of the soil; and if a crop was taken every
 “ year, by the introduction of turneps and clover,
 “ or by otherwise diversifying the crops, as is
 “ known to be the constant practice in many parts
 “ of England; a double advantage would proba-
 “ bly accrue to the farmer, and then the compa-
 “ rative excellence of the horse-hoeing method,
 “ as stated in his own account, might not be very
 “ great. Mr. Tull, (to whom I think his country
 “ greatly indebted for striking out a new path
 “ which may in some circumstances be followed
 “ with great advantages) is certainly a prejudiced
 “ writer, and too much attached to his own
 “ system. His book first induced me, some years
 “ ago, to try the horse-hoeing method, which I
 “ have continued ever since, and have applied to
 “ many plants of different kinds. These trials have
 “ been attended with various success: and though
 “ I dare not take absolutely upon me to say, that
 “ every farmer would find it more profitable than
 “ the way he was brought up in, yet will I ven-
 “ ture to promise any gentleman, who, with
 “ knowledge of the principles, and judgment,

* I must here beg leave to observe, that, if we reflect on
 the cold air descending from the Alps, so many months cover-
 ed with snow, and on the extreme heat of the summer’s sun,
 we shall, perhaps, find the climate in this kingdom full as
 favourable to vegetation.

“ and,

“ and, let me add, some resolution to withstand
 “ vulgar prejudices, shall attend the horse-hoeing
 “ husbandry, that he will be amply rewarded by
 “ the entertainment which this kind of culture
 “ affords; and the superior size and excellency
 “ which many plants will arrive at by horse-hoe-
 “ ing, will surprise him. I know no vegetable
 “ that proves this more fully than the turneps:
 “ consequently none fitter to begin experiments
 “ on.”

The gentleman to whom I owe the preceding account of his management of lucerne in Lincolnshire, adds, after the quotation before given* from his very sensible letter. “ You will perceive
 “ that I have entered deeply into the drill and horse-
 “ hoeing husbandry.—I took a great deal of
 “ pains with wheat, sowing three rows of it in
 “ lands five feet and an half broad, where it was
 “ horse-hoed so much that the ground became
 “ absolute dust. The corn grew very strong and
 “ fine, and the ears were large and well filled.
 “ However, at harvest, I had only seventeen shocks
 “ on an acre, whilst in some ground close to it,
 “ sown in the common way, I had 23 to an acre;
 “ but the straws were smaller, and the ears not so
 “ well filled. I believe that, shock for shock,
 “ the drill was the best; but acre for acre, the
 “ sown corn. I have sown my intervals, however,
 “ again with wheat, and have drilled some fresh
 “ lands.”

Both these gentlemen, and another, the achievements of whose illustrious ancestors grace the annals of the English history, but who likewise desires to conceal his name on this occasion, have favoured me with some very judicious remarks on the instruments used in the new husbandry: but

* Page 276—278.

as they did not come to hand till after that part of my work was printed off, I shall give them in an appendix, with whatever else, properly pertinent to the subject of agriculture, may be communicated to me, before the publication of the last part.

Most of the experiments related in the second volume of this work shew, that, taking them only as single crops, they were equal to those sown in broad cast, and raised at a much less expence, if we consider the saving in seed and manure: but if the produce of the same land is taken for several years running, the advantage is greatly in favour of the horse hoeing husbandry, in which the land, being never rested, brings a constant yearly return to the farmer. This difference will appear very considerable if we reckon, on the other hand, the loss of a crop, and the expence of a fallow. And another thing to be said in favour of the new method, is, that no person has yet continued it long enough, or made a sufficient variety of experiments, fully to ascertain it's value. This appears from the constantly repeated variations of that most judicious experimenter, M. de Chateauvieux; who yet declares, that he was not fully satisfied, of what breadth to make the beds, in what manner to sow the rows, or what quantity of seed it is most proper to use. These facts are so evident in many of his experiments, that I need only refer the reader to the calculations there given; for it would be needless to repeat them here.

Some farmers may object, that it would be wrong to attempt to render the practice of the horse-hoeing husbandry general; because it seems more than probable that the common broad cast way will do better for some plants, which, as they remain but a short time on the ground, grow thereby as perfectly as their nature admits of,
pro-

provided the land was in fine tilth and good heart when they were sown. The worthy gentleman before mentioned in Lincolnshire, confirms this by his own experience. "I tried barley twice," says he, in the horse-hoeing way, without any success; and oats the same: that is, I did not get so much corn by a considerable deal, as "in the common way*." But I must here observe, that the raising of these in the old way need not be a bar to the new husbandry; because the land will be fit to lay down in beds, for other plants, as soon as these are taken off, if it was in good order before.

What will infinitely enhance the importance of this husbandry, is the advantage which may arise from a judicious change of crops; an object which, unfortunately, has escaped the notice of that attentive observer, M. de Chateauxvieux: this kind of husbandry not having been introduced into his country.—He was so intent on trying what land would do with thorough plowing alone, that though he raised plants very different in their manner of growing, yet he did not think of raising them interchangeably on the same spot. Had this thought occurred to him, that clearness of judgment, and depth of penetration, with which he saw the advantageous consequences of every subject, would, undoubtedly, have befriended us greatly here.

Many writers have been of opinion that changes of crops are of essential service to the land, because, say they, each plant assumes, for it's nourishment, that part only which is proper for it's own particular food, without impoverishing the ground for any other plant. — Though I can hardly sub-

* I have, however, seen plants of oats which grew by accident in a bed of wheat, have a great number of stalks and ears, and a surprizing number of grains in each ear.

scribe to this opinion, yet, as real experience may have taught them a fact upon which they, perhaps, have reasoned falsely, by ascribing to the assimilation of particular juices only, what is more probably owing to the different effects which different roots may have on the soil; I make no doubt but that a judicious change of crops may be of proportionably greater advantage in the new husbandry, as, in this method, weeds, those obstinate and frequent enemies to the husbandman, can never get a head, but the land will be constantly preserved in good order. In short, it is only extending over the whole kingdom, what we daily see practised in the garden grounds around London: and it is more than probable, that equal culture will be attended with equal success, in every place.

M. de Chateauvieux's experiments prove, that manure is not so essentially necessary towards obtaining plentiful crops, as it is generally supposed to be; and that the plants cultivated chiefly by thorough plowing, are rather superior to those raised in well dunged fields: though I will not go so far as some have done, when they alledge, that plants acquire, not only a disagreeable relish (in which they are certainly right), but even something hurtful, if not poisonous, from dunge.

This change of species becomes the more advisable, when we reflect, that a crop of some of the before mentioned roots is of equal, or rather superior, value to a crop of wheat: and this again will strike us yet more strongly, if we consider the quantities produced on an acre of land, and how far they will go in the feeding and fattening of all kinds of cattle. The inhabitants of Britany, from a confirmed experience of their use, reckon, as was observed before, a full crop of parsneps equal in

¶ See TULL's *Horse-hoeing Husbandry*, c. 4.

value

value to three middling crops of wheat: and that they do not err in this estimate will appear very probable, if we make, in the same light, a calculation grounded upon the success of M. de Chateauvieux's experiments on carrots; especially as parsneps grow to a larger size, and are at least equally substantial food.

I will suppose, for example, five quarters of wheat to be reaped from an acre of land, a crop which not one acre in ten yields throughout England; and I will estimate this at the parliamentary price of 6 shillings a bushel; that is to say, 48s. a quarter; this being a price at or below which our government grants a bounty on exportation. At this rate, the produce of the acre will be worth twelve pounds.—The difference between the price of a lean bullock, and that of a fat one, cannot, upon a medium, be less than three pounds. Now a bullock may be completely fattened in three months, at farthest; and as experience has shewed that it can eat two hundred pounds of turneps in a day, I will allow daily one hundred pounds of carrots, or parsneps, which, being a much more substantial and more nourishing food, will certainly be very sufficient. In this case, the smallest quantity computed on an acre (page 180 of this volume), *viz.* 19,000 pounds, will feed a fatting bullock 190 days: but if the computation of 28,506 pounds (as in page 181) is admitted, this will maintain a bullock 235 days; and as a bullock is generally fattened in three months, an acre of land will, with the first of these crops, fatten two bullocks, and with the second, three. Mr. Millar, from information, declares, (p. 181), that an acre of carrots will go as far as three of turneps: from whence it follows, that my above allowance is probably more than any bullock can eat. This will appear still more probable, if we judge

judge by the estimation which the people of Brittany set upon their parsneps. It will likewise appear from hence, that these crops are at least full as valuable as a crop of wheat; besides the farther consideration of their remaining but one season in the ground. The reader will here observe, that I have over-rated the crop of wheat, and under-rated the value of the roots.

Experience has proved, and it will presently be instanced again, that all roots, as well as pulse and pot-herbs, grow better when planted in drills and horse-hoed, than they do in broad cast. Consequently the new husbandry seems to be the most eligible, in proportion to their superior value.

Another great recommendation of the new husbandry, is that clays and all binding soils are thereby brought into good order, much more effectually, and indeed sooner, than they can possibly be in the old way, unless a fallow be continued for two successive years, and managed at an extraordinary expence, especially of very deep plowings. This appears evidently from several of M. de Chateaufieux's experiments, and particularly from that very remarkable one of the potter's clay, so often alluded to in the course of this work, and related at length in p. 259 of the first volume, to which the reader is referred.

As farther proofs in favour of the new husbandry, I shall here give another extract from the letter I have been favoured with from Lincolnshire, and then add a few experiments made by M. de Chateaufieux, on plants which scarcely any other person would, perhaps, have thought of cultivating with the horse-hoe, but which afford complete demonstrations of the excellency of this method.

“Peas, says the former of these good authorities, succeeded prodigiously with me when managed

"naged with the horse-hoe. They not only grew a great deal of straw, but were also well corned. The crops were full double to those sown in the common way, on the adjoining land.

"I also sowed beans on my land, contrary to the advice of all my farmers, who told me it was too light for beans, and that, if they grew at all, they would never corn. Notwithstanding this, I ventured to sow them, and horse-hoed them carefully. They did not, indeed, grow very high: but they had as many pods, and as well filled, as those in strong clays.

"Turneps I did not succeed so well with. Indeed the difficulty of sowing so small a seed discouraged me: though at my first trial, I got as many good turneps without manure, as in the next close, with manure, but not so many of them, and consequently not so good a crop."

In 1753^c, M. de Chateauvieux planted a bed of colliflowers, in ground which had not been dunged for several years, but which was in fine tilth. They were transplanted on the 9th of June, cultivated with the horse-hoe, and on the 20th of August, he cut the two first heads*, which were very fine, and of an excellent taste.

Cardoons, which he cultivated in the same manner, grew very fine, though they were greatly retarded by a shower of hail; and a row of asparagus,

^c DUHAMEL, *Culture des Terres*, Tom. III, c. 1. Art 9.

* This was remarkably early for the country here spoken of (*viz.* the territory of Geneva): for it is very rare, either there, or even in France, that colliflowers are fit to cut before Michaelmas.

Mr. Miller is very right in observing that the culture of this plant has been improved in England much more than in any other part of Europe. Holland is generally supplied with it from hence: Germany knew not what a colliflower is, till within a few years past: and even now, most parts of Europe are supplied with it's seeds from England.

ragus, which he planted in a bed six feet wide, and managed in the same way, made good shoots even in the first year^f.

“ I have, says he, continuing this account of his progress in the new husbandry, likewise communicated to M. Duhamel^g, several beds six feet wide, which I have planted with single rows of strawberries. The vigour of the plants, the largeness of their leaves, and the very great number of their roots, give me room to expect that the fruit will be very large and plentiful^h.

“ The success I have already had, the care with which this culture is performed, the advantage of not using dung, and that of being eased of the trouble of watering, so necessary in kitchen gardens, that, in hot weather, it takes up almost the whole of one man’s time, are considerations of such weight, that they determined me to continue these experiments^h.

“ In 1754, my strawberries were admirable, extremely large, finely scented, and of a very high flavour. The asparagus, which was in it’s second year, was as fine as any in the best cultivated gardens. Artichokes planted at the end of May, produced in September their first fruit, which was, in general, from twelve to fifteen inches in circumference. Their leaves covered entirely the beds six feet wide.

^f *Ibid.*

^g *Ibid.*

^h *Ibid. Tom. IV. c. 3. Art. 11.*

The colliflower was first brought to us from the island of Cyprus, where it is said now to be in very high perfection; though it is supposed to have been originally carried thither from some other country. It was not brought to any degree of perfection, till about the year 1680: at least it was not sold in the markets here before that time: but since the year 1700, our gardeners have improved it’s culture so much, that colliflowers which were formerly thought very fine ones, would be little regarded now. *Gardener’s Dict. Art. BRASSICA.*

“ I have

" I have raised even melons in the same manner, without any dung, or hot-bed, and without bell-glasses, or any glass frame to cover them. I sowed them as I would have done wheat. The plants came up perfectly well, and the fruit was so large and finely flavoured, that it might claim a preference in all respects to any that grew in my garden.

" I cultivated the same plants again in 1755, and 1756, in the same manner, and with the same success, as before. They have always been larger, better tasted, and in every respect finer, than those of my kitchen garden. Nothing could be more striking, than" (as was observed before, speaking of the pot-herbs which were a part of these experiments) " in 1755, a hot dry year, to see these plants, always green, and in great vigour, thrive without any alteration, while those in gardens, which were watered every day, drooped during part of the day, and grew but very slowly.

" We may place the greater confidence in these experiments, as the same plants have been cultivated in the same manner for several years, and always with equal success. Their beauty, largeness, and vigour, cannot be imputed to dung or other manure, for none was used: nor did they want watering, to which I never had recourse, but when any of them were transplanted. It is therefore to the culture that their flourishing growth must be ascribed: and this is the more remarkable, as it is well known, that, in the common management of kitchen gardens, if the ground was not to be dunged for several years, it would produce only poor and stunted plants."

M. de Chateauvieux extended the new husbandry even to the culture of the teazle, or fuller's

thistle^h, which grew to a surprizing height, and produced an extraordinary number of the finest and best heads that the fullers in his country had ever seen.

This plant is of such importance to the woollen manufactory, that, as I may, perhaps, not have occasion to mention it again in this work, I must beg leave to add here Mr. Miller's directions for the culture of it, though foreign to my present subject.

"It is propagated by sowing the seeds in March, upon a dry soil. About one peck of this seed will sow an acre; for the plants should have room to grow; otherwise the heads will not be so large, nor in so great quantity. When the plants are come up, you must hoe them in the same manner as is practised for turneps, cutting down all the weeds, and singling out the plants to about six or eight inches distance; and as the plants advance, and the weeds grow again, you must hoe them a second time, cutting out the plants to a wider distance: for they should be, at last, left at least a foot asunder: and you should be particularly careful to clear them from weeds, especially the first summer; for when the plants have spread so as to cover the surface of the ground, the weeds will not so readily grow between them. The second year after sowing, the plants will shoot up heads, which will be fit to cut about the beginning of August; at which time they should be cut and tied up, in bunches, setting them in the sun, if the weather be fair; but if not, they must be set in rooms, to dry. The common produce is about an hundred and sixty bundles, or staves, upon an acre, and they will sell for about one shilling a staveⁱ."

DUHAMEL, *Culture, des Terres*, Tom. IV. c. 3. Art. 12.
Gardener's Dict. ART. DIPSACUS.

"Though

Though the culture of perennial plants, such as sainfoin, lucerne, and burnet, does not strictly belong to the new husbandry; yet, as it is probable that their growth is considerably benefited, on the principles of this method, by the stirring of the earth between the rows; I beg to charge to this account, the advantages arising from thence: advantages which, if duly attended to, are of great national importance. To be satisfied of this, let us but reflect a moment on the profits accruing from lucerne, as proved by some of the foregoing experiments.

It appears from M. de Chateauvieux's experiments (p. 265), that an acre of lucerne will produce above six loads of dried hay; from M. Diancourt's (p. 271), that even ten loads and an half may be had from the same extent of ground; and M. Duhamel himself (p. 271), had seven loads. Now Mr. Miller says^k, he has been assured by persons of undoubted credit, who have cultivated this plant in England, that three acres of it have fed ten cart horses from the end of April to the beginning of October, without any other food, though they have been constantly worked.

The importance of the new husbandry will appear yet more considerable, if, viewing it in a national light, we attend to the extent of ground employed to feed a horse in the usual way. One horse there consumes the produce of three acres, in hay and corn: whereas the produce of one acre, for instance of lucerne, will certainly maintain one horse all the year. Burnet promises to do the same. Consequently the number of horses in this kingdom may be tripled. If we make the same comparison of the ground taken up by the plants before mentioned, *viz.* carrots, parsneps, turneps, &c.

^k *Gardener's Dict.* Art. MEDICA.

with that which is now employed to raise grass, hay, and corn, for the feeding and fattening of cattle; we shall find at least the same proportion take place.

If again, we compute, in the same manner, the land now under corn in this kingdom, we might estimate one third to be fallow; but I will suppose it to be only one fourth: and if we reckon the crops, for instance of wheat, to be, in general, under three quarters to an acre; and that, from land kept constantly in so excellent order as it is in the new husbandry, we might expect four quarters; the difference to the nation will become very great indeed: such as perhaps, no political arithmetician has yet dreamed of: — and the number of people may be proportionably increased.

Another circumstance attending the general practice of the new husbandry, in point of population, is, that as the land will yield a greater increase of it's various productions, and that increased variety will require a greater attention than is usually bestowed on farms, these must, in general, become much less extensive than they now are: and the certain consequence of this will be, that the number of farmers and labourers being increased, the number of people in the country, the only source of population, will also be greatly augmented. If we look around this kingdom, and remark the numbers of acres lying waste and uncultivated, and then add thereto the happy consequences of an improved culture of the rest; a very great, and a new source of population immediately presents itself. — This surely deserves the most serious attention of the Legislature, and of every individual who is possessed of wastes and commons.

C H A P. IV.

OF NATURAL GRASSES.

ALL the plants which require frequent culture in order to their being improved, for the food of cattle, having now been treated of; I proceed to the production of natural grasses, commonly called pastures, which the writers on husbandry rightly commend as the cheapest, easiest, least hazardous, and most profitable branch of farming.

It is surprising to think, how long a due attention to this important object has escaped the notice of mankind, and how much the easy means of making a proper advantage of the bounteous gifts of nature, in almost every country, have been strangely neglected and overlooked; for, as the author of the *Swedish Pan*^a most judiciously remarks, though plants have been constantly obvious to the eyes of every man, nothing has been delivered down to us in any book, concerning the kinds of plants proper for the different kinds of cattle: the consequence of which inattention frequently is, that the farmer, by not distinguishing and selecting the seeds of proper grasses, fills his pastures with weeds, or, which is here equivalent to them, with bad grasses, unfit for the nourishment of the creatures which he intends to rear.

The illustrious Linnæus, in his journey through Dalecarlia, in the year 1734, made the first attempt to lay down rules for the farmer's guidance in this interesting concern, as may be seen in the *Flora Lapponica* (p. 158), where he says: " In my

^a N. HASSELGREN. *Amœnit. Academ. Suec. Tom. II.*

“ journey through Dalecarlia, when we had climbed up the mountains and were got into Norway, my fellow travellers being tired and asleep, I wandered about in a thick wood, and soon perceived that the horses easily distinguished wholesome from noxious food: for, being very hungry, they devoured all sorts of plants, except the following, *viz.* meadow-sweet, valerian, lilly of the valley, angelica, loose-strife, marsh-cinquefoil, crane’s bill, hellibore, monk’s hood, and several shrubs.” This gave him a hint to recommend to the curious to set about examining what plants such animals as live on vegetables will not touch.

The ingenious author of the fore-mentioned *Swedish Pan*, in order to encourage inquiries of this kind, very properly observes, that we admire the wisdom of the Creator, which has made some vegetables absolutely disagreeable to some animals, while they are agreeable to others; and plants which are poisonous to some, but very wholesome to others. This did not happen by chance, but was ordained for wise purposes. For if the author of nature had made all plants equally grateful to all kinds of quadrupeds, it must necessarily have happened, that one species of them having remarkably increased, another species must have perished by hunger, before it could have got into better pasture. In like manner we find it contrived in relation to the plants themselves, which do not all grow in the same country and climate; but every plant has it’s place, in which it grows more abundantly than elsewhere. From hence we may observe, that those animals which chiefly live upon particular plants, abound most in certain places. Thus one animal leaves that which to itself is poisonous, to another animal, which feeds upon it deliciously. Long-leaved water hemlock

lock will kill a cow, whereas the goat browses upon it greedily. Monk's-hood kills a goat, but will not hurt a horse. Parsley is deadly to small birds, while swine eat it safely; and pepper is mortal to swine, and wholesome to poultry. Hunger will often drive animals to feed upon plants which nature never intended for them: but after this has happened once, they become more cautious for the future.

Without pretending to say whether the late fatal distemper among our horned cattle may have been owing to an unfortunate mixture of some noxious plant, or plants, among their food; to a vitiated quality of the water which they drank, or to an infection in the air; or whether either of these is, in any shape, the cause of that dreadful scourge which still continues to afflict several of the northern parts of Europe, where whole herds are swept off almost instantaneously; the following passage in the great Linnæus's writing upon a similar subject, is an excellent example of the method of enquiring into the causes of the diseases of cattle.

"When I arrived, says he, at Tornea*, the inhabitants complained of a terrible disease that raged among the horned cattle, which died by hundreds, soon after their being let into the pastures in the spring. They desired that I would consider this affair, and give them my advice what was to be done, in order to put a stop to this evil. After a proper examination, I thought the following circumstances worth observing.

"1. That the cattle died as soon as they left off their winter fodder, and returned to grazing.

* A city in Sweden, in the province of Bothnia; at the bottom of the Botner-sea. It is also sometimes called Tornø Lapmark, from it's being situated near Lapland.

" 2. That the disease diminished as the summer came on; at which time, as well as in the autumn, few died.

" 3. That this distemper was propagated irregularly, and not by contagion.

" 4. That, in the spring, the cows were driven into a meadow near the city, and that they chiefly died there.

" 5. That the symptoms varied much, yet agreed in this; that the cattle, upon grazing indiscriminately on all sorts of herbs, had their bellies swelled, were seized with convulsions, and in a few days expired with dreadful bellowings.

" 6. That no man dared to flea the recent carcases; as they found by experience, that not only the hands of such as attempted it, but their faces too had been inflamed, and mortified, and that death had ensued.

" 7. The people enquired of me, whether there were any kinds of poisonous spiders in that meadow; or whether the water, which had a yellowish tint, was not noxious.

" 8. That it was not a murrain was clear, because the distemper was not contagious, and because that distemper is not peculiar to the spring. I saw no spiders, but what are common all over Sweden; and as to the water, the sediment at the bottom, which caused the yellowness, was nothing but what came from iron.

" 9. I was scarcely got out of the boat which carried me over the river into the meadow, before I guessed the real cause of the disease. For I there beheld the long leaved water hemlock. My reasons for guessing this were as follow.

" 10. Because in that meadow, where the cattle first fell ill, this poisonous plant grows in great plenty, chiefly near the banks of the river. In other places it was scarce.

" 11. The

“ 11. The least attention will convince us, that brutes shun whatever is hurtful to them, and distinguish poisonous plants from those which are salutary, by natural instincts; so that this plant is not eaten by them in the summer and autumn; which is the reason that, in those seasons, and in the place I here speak of, few cattle die, *viz.* only such as either accidentally, or pressed by extreme hunger, eat of it.

“ 12. But when they are let into the pastures in spring, partly from their greediness after fresh herbs, and partly from the emptiness and hunger which they have undergone during the winter, they devour every green thing that comes in their way. It happens moreover that herbs at this time are small, and scarcely supply food in sufficient quantity. They are besides more juicy, are covered with water, and smell less strong: so that what is noxious is not then easily discerned from what is wholesome. I observed likewise, that the radical leaves were always bitter, and the others not; which confirms what I have just said.

“ 13. I saw this plant in an adjoining meadow mowed along with grass for winter fodder; and therefore it is not wonderful that some cattle, though but a few, should die of it in winter.

“ 14. After I left Tornea, I saw no more of this plant till I came to the vast meadows near Limmingen, where it appeared along the road; and when I got into the town, I heard the same complaints, as at Tornea, of the annual loss of cattle, with the same circumstances.

“ 15. It would therefore be worth while to eradicate carefully these plants, which might easily be done, as they grow in marshy grounds, and generally by the sides of pools or rivers. But if this cannot be executed, the cattle should not be suffered to go into such places, at least during the

spring: for I am persuaded, that later in the year they can distinguish this plant by the smell alone*."

From experiments carefully and judiciously performed on the above extensive, beneficial, and highly rational plan, we may know with certainty for what species of animals any pasture affords the best nourishment. We see, for example, heifers waste away in enclosures where the meadow-sweet grows in abundance, and covers the ground so that they can hardly make their way through it: while the country people, imagining that the pasture is too rich for them, are quite amazed, and do not dream that the meadow-sweet affords them no nourishment: whereas the goat, which stands bleating on the other side of the hedge, is not suffered to go in, though he longs to be browsing upon this plant, which to him is a most delicate and nourishing food. Long experience has taught us, that sheep take up poison in marshy grounds, though no one, says M. Hasselgrew, till lately, knew what was the particular poison. Yet the spiderwort, the mouse-ear scorpion grass, the mercury, the sun-dew, the hairy wood grass, the lesser spearwort, the butterwort, have evidently suspicious marks. The *andromeda*, which the people of New-York call dwarf-laurel, is known to be a most rank poison to sheep in Virginia, and very fatal to the same kind of creatures in New-York. Of the same genus is the wild rosemary, a species of the *andromeda*, which infests the pasture in the northern parts of Sweden; and equally destructive was the plant which the Marquis of Tur-

* In the spring, when water hemlock is under water, cows and oxen cannot smell it: but when the summer is come, and has dried the ground, they are very careful not to touch it.

billy judiciously points out the means of extirpating in the pastures of Anjou^c.

Mr. Stillingfleet observes^b on the above remark in the *Swedish Pan*, that there is great reason to think that what makes low grounds so noxious to sheep is not the moisture, but the plants which grow there: for it is noticed by shepherds, that the great danger to sheep is immediately after a fresh spring of grass, at which time he suspects that they lick up the young and tender shoots of poisonous plants, along with their proper food; not being able then to distinguish the one from the other.

From observations of this kind, continues the author of the *Swedish Pan*, the husbandman may form a right judgment of his meadows, and be very sure that some are vastly preferable to others for certain animals: for although cattle, pressed by necessity and hunger, will feed upon vegetables less grateful to them; yet it is not to be doubted but that they are not so well nourished by these, as by others. “ Thus the Dalecarlians are obliged, “ in a scarcity of wheat, to support themselves by “ bread made of the bark of the pine: but it does “ not, by any means, follow, that this affords proper nourishment. Horses, in time of war, when “ urged by extreme hunger, will crop even dead “ hedges: but we cannot thence conclude, that “ wood is good food for them.

“ The industrious farmer may judge from hence, “ when he sows his meadows, with hay seeds for “ pasture, that it is not indifferent what kinds of “ seeds he chooses, as the vulgar inadvertently “ think: for some are fit for horses, others for “ cows, &c. Horses are nicer in choosing than

^c See Vol. I. p. 185.

^b *Miscellaneous Tracts*, p. 355, note c

“ any of our cattle. Plants whose seeds grow in
 “ pods are particularly not relished by them.
 “ Goats feed upon a greater variety of plants than
 “ any other cattle; but then they chiefly hunt
 “ after the extremities and flowers. Sheep, on the
 “ contrary, pass by the flowers, and eat the leaves.
 “ And again, different animals have different dis-
 “ positions as to grazing more or less near to the
 “ ground*. The husbandman who understands
 “ these things, and who, in consequence thereof,
 “ knows how to lay out his lands, so as to assign
 “ to each kind of cattle it’s most proper food,
 “ must necessarily have his flocks and herds
 “ healthier and fatter, than he who is unacquaint-
 “ ed with these principles. The good manager will
 “ observe the same precautions in the making of
 “ his hay: for although many herbs are eaten
 “ when dry, which would be refused while green, it
 “ does not from thence follow that they yield good
 “ nourishment. Much might be added concern-
 “ ing the propensity of cattle to this or that plant:
 “ for example, that sheep delight, above all
 “ things, in the fescue-grass (*festuca*), and grow
 “ fatter upon it, than on any other kind of grass;

* Animals with incisory teeth in both jaws, as the horse and
 ass, nip more easily short herbage, than those whose upper
 jaw is without the incisory; and if the sheep and goat cut the
 herbage very close, it is owing to the smallness and thinness of
 their lips; but the thick lipped ox can only crop the long her-
 bage; and this is the true reason why he never injures the pas-
 tures in which he lives. As he crops only the extremity of the
 young herbage, he does not effect the root, and retards it’s
 growth but very little; whereas the sheep and goat, by nipping
 the herbage very close, both destroy the stem and injure the root.
 The horse chooses the most slender herbage, while the
 larger, whose stems are hard, he leaves to feed and multiply:
 whereas the ox crops those thick stems, and by degrees destroys
 the coarser herbage. Hence it is, that after some years the
 herbage where a horse had lived becomes coarse; whereas that
 where the ox has fed becomes a fine pasture. DE BUFFON,
Natural History of the Horse, &c.

“ that

“ that goats prefer certain plants, but, being led
 “ by an instinct peculiar to themselves, they search
 “ more after variety, and do not willingly stick
 “ long to any one kind of food; that geese are par-
 “ ticularly fond of the seeds of the fescue grass;
 “ that swine hunt greedily after the roots of the
 “ bull-rush, while they are fresh, but will not touch
 “ them when dry. It is an error to think, as many
 “ of our (the Swedish) peasants do, that hogs,
 “ when they turn up the ground in quest of scor-
 “ zonera roots, or of clowns-all-heal, or wound-
 “ wort, eat the roots of couch grass; for they never
 “ touch these, but when pressed by the utmost ne-
 “ cessity.”

In like manner, adds Mr. Stillingfleet, in a note upon the above passage, a notion prevails among us, that cows eat the crow-foot which abounds in many meadows, and that this renders their butter yellow; from whence this plant derives its common name of the butter-flower. But he believes that this is a mistake, because he never could perceive that any part of the crow-foot was touched by cows or any other cattle*. Linnæus too observes^b, that some people imagine that the march-marigold makes butter yellow; though, in reality, cows never touch that plant. He thinks, however, that all kinds of pasture will not give that yellowness, and then remarks, that the best and yellowest butter

* This agrees with Mr. Lisle's observation^a, that several species of the meadow ranunculus, or crow-foot, are common in our meadows; that they blister and ulcerate the flesh while they are green, and that cattle will not touch them in that state: but that they will feed on them greedily, after they have been dried and made into hay. — Dr. (afterwards Sir Hans) Sloan mentions this, to account for the cassvis root, which, though a strong poison when green, makes wholesome bread after it has been baked.

^a *Observations in Husbandry*, Vol. II. Art. GRASSES, §. 63.

^b *Flor. Lappæ*, p. 195.

he ever saw, and which is preferred to all other sorts by the dealers in the places where it is made, proceeds from the milk of cows fed where the cow-wheat grows in greater plenty than he ever knew elsewhere. A proof how very incurious the country people are in relation to things they are every day conversant with, and which it concerns them so much to know.

M. Hasselgren continues thus. "The animals ought not to be over hungry, when we make our experiments, if we intend to make them properly : for, at such a time, they will greedily devour most kinds of plants, which they would absolutely refuse at another. Thus, when they come immediately out of the house, they are not fit to make experiments upon ; because they are then ravenous after every green thing that comes in their way. Besides, some plants are eaten by them in the spring, which they will not touch all the summer, when they are apt to grow rank in taste and smell, and become stalky and hard. The best method is, to make the experiment when their bellies are almost full ; for they are hardly ever so entirely : and another caution to be observed, is that the plants be not handled by sweaty hands ; because some animals will, in that case, refuse even the most palatable. They should be thrown upon the ground, and if the animal refuses to eat them, let them be mixed with other sorts which are known to be liked. If they are still refused, the proof is sure ; especially if it be tried with several individuals of the same species."

A gentleman who has at heart the improvement of his own fortune, as well as the good of the public, should not only make experiments as to the plants which are eaten most greedily by different cattle, but he should also have what I would call

call a field of experiments. He should have seeds of every kind of plants which he sees thrive, and which had not yet been sown alone, gathered free from any mixture, and he should sow these in that field, in order there to view it's growth, to try the most proper way of cultivating it, and to be able to extend his observations, on it's use to various creatures. The usefulness of such a spot appears by the important addition which Mr. Rocque has made to our artificial pastures, by introducing burnet into them, which he was enabled to do, only by it's being planted by itself.

I may certainly, with Mr. Worlidge^b, assure the farmer, that “there are many most rare and excellent plants, which, if they were advanced or propagated so as openly to manifest their worth, might be of much more advantage to the laborious husbandman, than the short, four, and naturally wild and barren grass, mixed with a super-abundant proportion of pernicious weeds. Therefore it would be very acceptable service to the whole nation, if those who have land enough, would yearly prove some small proportion of these and other vegetables, not yet brought into common use: by which means they would not only advance their own estates, but the whole nation in general, and gain to themselves an everlasting fame and honour, as did the families of Piso, Fabius, Lentulus, and Cicero, by bringing into use the several pulses from which they derived their names.”

Mr. Miller, sensible of the advantages of this method, tried to save the seeds of various kinds of grasses, unmixed, in order to determine their qualities; but not having ground enough to propagate them separately in any quantity, he was obliged to abandon this pursuit: but he strongly

^b *Systema Agriculturae*, p. 32.

recommends to persons who have sufficient skill and leisure, with land to spare for experiments of this kind, to carry into execution this plan, which, as he justly observes^c, may be of singular service to the public.

Pastures are naturally divided into meadows and upland. It is very seldom that we meet with the one or the other in so good condition, but that they are either over-run with moss and weeds, or the soil itself is in so bad a state, as to require being mended before any improvement can be made.

There is no part of husbandry, with which farmers in general are less well acquainted, than with that which relates to pastures. I shall therefore be as particular as possible in my directions here. To this end, I shall begin with the means of improving the soils for meadows and upland pastures; then give the names and culture of the different grasses recommended by authors; and lastly, the improvement of pastures already laid down to grass.

SECT. I.

Of the improvement of Soils for Pastures.

MEADOWS, lying low, and generally level, are subject to be wet, or overflowed, especially in the winter: but it would be needless to repeat here any part of the ample instructions before given for draining land^{*}; nor will it be necessary again to treat of the differences of soils, any farther than may be requisite in order to give some particular directions to fit them for the purposes of pasture.

^c *Gardener's Dict.* Art. GRAMEN.

^{*} See Vol. I. p. 132. and 176.

Meadows, being generally enriched with the fine mould washed down from the adjacent rising grounds, are usually for a good soil, and seldom require any other improvement, than the removing of temporary imperfections. But they may likewise be of such a nature as to stand in need of a more particular treatment; as is the case when their surface is a mossy loose earth, or when it is of a binding or clayey quality.

If, through long neglect, a coarse strong grass, rushes, or other bushy plants, be suffered to remain upon the ground till they rot there, they will, in some years, form a loose spongy substance, somewhat resembling the moss described in my first volume †. In this case, the first necessary step is to pare off and burn that loose surface, or at least so much of it as to enable the plough afterwards to reach the better soil underneath. The manner of doing this has already been explained so very amply ‡, that it will be sufficient to add here, that this loose upper earth must be so strengthened as to afford sufficient stability to the roots of whatever plants are sown on it, by mixing it well, either with the better soil underneath, or with marle, clay, or rich loam, brought to it from the neighbouring grounds, or with the composts before directed for this purpose §.

If the soil is clay, or a strong binding earth, the treatment of it is much the same, whether it be meadow or upland pasture. Such soils, by retaining water in every hollow place, become what the farmers call *four*, and produce a coarse grass, composed, as Mr. Miller observes ^h, of bad weeds, of which the several sorts of docks make no small share. Although many of the meadows produce

† Page 125.

‡ See Vol. I. c. 1. §. 4. art. 3. and c. II. §. 2. and 3.

§ Vol. I. p. 157. & *seqq.*

^h *Gardener's Dict.* Art. MEADOW.

a great burden of what the country people call hay, yet this is fit only for such cattle as, by hard labour and hunger, are driven to eat it: for horses which have been accustomed to feed on good hay, will almost starve rather than touch this. A plain proof of it's being disagreeable to all cattle, is, that when they are turned in, after it has been mowed, we often see the ground covered with rank weeds, which they will not meddle with.

When a pasture is in the state above described, if there is a sufficient depth of soil to admit of it, the surface should be pared off, and burnt: and as such places are usually over-run with ant-hills, these should also be burnt; after which, by the addition of proper manure, as directed for the improvement of strong soils*, and by the help of deep plowing, the land should be brought into fine tilth. The deeper this improvement goes, the deeper and more lasting will the grass be. I have been informed of a particular instance of the good effects of this method, by which the gentleman who practised it had grass which continued for years in a strong state of vegetation, and was constantly near a month forwarder than that of his neighbours, whose soil and situation were exactly the same.

Let not any one be deterred by the expence attending this improvement: for the crops of grain and other plants taken while the soil is thus preparing, will nearly repay all the charges, and the ground will afterwards yield much more plentiful crops of grass; at least for a number of years. But as clayey lands require more frequent and more thorough repairs than other soils, the returns of tillage proposed by Camillo Tarello will be the most proper means of managing them.

* Vol. I. p. 19. and 110.

He^d would have farmers divide their pastures into four parts, keep one of these parts under grain or pulse, during five years, and at the expiration of that time lay it down to grass as before; and so proceed with every other part. He proposes, that the first breaking up should be by paring and burning, and thorough plowing. But if I may differ from him in opinion, I think 'tis needless to keep the ground so many years in tillage, unless this should suit the husbandman's convenience for the culture of particular plants. In this case, the pasture may be divided into five or six parts. After each part has thus been in tillage, Tarello advises breaking up again the spot first began with; though not by burning now, but only by plowing, in order to sow it as before. "This," says he, will be profitable to the husbandman, and improve the pasture. It will benefit the husbandman, because he will thereby raise a greater quantity of corn; and it will do good to the pastures, because nothing is more serviceable to them, than this renewal of their surface, as is attested by Columella^e. Let not the husbandman imagine that he will have less hay when only three fourths of his usual extent of land are under grass: for, in fact, it is not the quantity of the land, but the care which is taken of it, that gives plenty of hay."

When a soil of this kind is laid down for meadow, great care should be taken to slope it down gently, from the middle, in such manner that no water may rest on any part of it. If the extent is large, small ditches should intersect the meadow into as many divisions as shall be necessary to form a sufficient drain for the waste water, and the spaces

^d *Ricordo d'Agricoltura*, p. 7.

^e *De Re rustica*, Lib. II. c. 18.

between these ditches may be gently raised. In an upland pasture on such a soil, ridges should be raised inclining a little from the horizontal, that the furrows may be so many drains, as before directed † in the plowing of such soils, to prevent their becoming spewy or wet: for as the rain cannot descend beyond the clay, it will glide along it, till, collected in such quantities as to form a small stream, it issues forth at the surface, usually loaded with some mineral quality imbibed from the earth underneath.

When the soil is a rich or light loam, the plough will not be so necessary; as such meadows or pastures may be repaired by the means which will be pointed out in the directions hereafter given for the improvement of meadows already laid down to grass.

SECT. II.

Of the names and culture of the several Grasses fittest for Pastures.

I Must here observé once more, with Mr. Stillingfleet ‡, that it is wonderful to see how long mankind has neglected to make a proper advantage of plants of such importance as grasses are, and which are the chief food of cattle in almost every country. The husbandman, for want of distinguishing and selecting grasses for seed, fills his pastures either with weeds, or with bad, or improper, grasses; when, by making a right choice, after some trials, he might be sure of having the best grass, and in the greatest abundance that his land admits of. In the common way of pro-

† Vol. I. p. 283.

‡ *Observations on Grasses, in his collection of Miscellaneous Tracts*, p. 365.

ceeding

eeding, if a farmer wants to lay down his land to grafs, he either takes his feeds indifcriminately from his own foul hay-rick, or fends to his neighbour for a fupply. By this means, befides a certain mixture of rubbifh, which muft neceffarily happen; it is not unlikely, but that what he intends for dry land may have come from moift, where it grew naturally, and fo on the contrary: and the confequence of this flovenly method frequently is, that the ground, inftead of being covered in one year with a good fward, is filled with weeds not natural to it, which would never have fprung up, if they had not been brought thither.

“ Arguments, fays my abovementioned author, “ are never wanting in fupport of antient customs, “ and I am no ftranger to thofe, fuch as they are, “ which prejudice and indolence have made ufe “ of on this occafion.

“ 1. Some fay then, that if you manure your “ ground properly, good graffes will come of “ themfelves. I own they will. But the queftion “ is, how long it will be before that happens: and “ why be at the expence of fowing what you muft “ afterwards try to kill? which muft be the cafe, “ as long as people fow all kinds of rubbifh under “ the name of hay feeds. Again, if the beft way “ is to let the ground take it’s chance, why is the “ farmer at the expence of procuring the feeds of “ the white, and broad clover, which come up in “ almoft all parts of England fpontaneoufly? But “ if this is allowed not to be the beft way in relation to clover of any kind, what reafon can be “ in nature, why grafs feeds only ought not to be “ fown pure?

“ 2. Others fay, that it is better to have a mixture of different feeds. I will fuppofe this to be true. But cannot a mixture be had though the feeds be gathered, and feparated? and is not

“ mixture by choice more likely to be proper
 “ than one by chance? especially after a sufficient
 “ experience has been had of the particular vir-
 “ tues of each sort, of the different kinds of cattle
 “ which each grass is most adapted to, of the
 “ different grounds where they will thrive best,
 “ &c. all which circumstances are now, in gene-
 “ ral, wholly unknown, though of the utmost con-
 “ sequence.

“ 3. It is said by some, that weeds will come
 “ up along with the grass. No doubt of it. Can
 “ any one imagine that grass seeds should be ex-
 “ empted from what happens to every other kind
 “ of seeds? But I will venture to say, that not
 “ near the quantity of weeds will spring up which
 “ they imagine, if the grass be sown very thick.
 “ Men must be very much put to it, when they
 “ make such objections as this last, or indeed any
 “ of the others. I am almost inclined to say with
 “ a great writer, “ It is a simple thing to take
 “ much pains to answer simple objections.”

“ One would hardly think it possible that the
 “ slovenly method of proceeding here complained
 “ of could prevail universally: yet this is the case
 “ as to all grasses, except the darnel (or rye) grass,
 “ and what is known in some few countries by the
 “ name of the Suffolk grass; and this latter in-
 “ stance is owing, I believe, more to the soil, than
 “ to any care of the husbandman. Now would
 “ the farmer be at the pains of separating, once
 “ in his life, half a pint, or a pint, of the different
 “ kinds of grass seeds, and take care to sow them
 “ separately; in a very little time he would have
 “ wherewithal to stock his farm properly, accord-
 “ ing to the nature of each soil, and might at the
 “ same time spread these seeds properly over the
 “ nation, by supplying the seed-shops.

“ I have

" I have had frequent experience how easy it is to gather the seeds of grasses, having several times employed children of ten or eleven years old, who have gathered many sorts for me without making any mistakes, after I had once shewn them the sorts I wanted.

" I have procured thus the creeping bent, the fine bent, the sheep's fescue, the crested dog-tail, &c. in sufficient quantities to begin a stock; but, for want of a proper opportunity of cultivating them myself, or meeting with any one who had zeal enough to bestow a proper care on them, my collections of this kind hitherto have only proved, that the scheme is in itself feasible.

" In the year 1761, a little boy gathered, by my directions, as much of the crested dog-tail, in three hours, by the side of a road, as, when shed, yielded upon weighing above a quarter of a pound averdupois, perfectly free from husks. As this seed is small, the skilful may easily judge how far such a quantity would go if properly employed.

" My very estimable and ingenious friend, Mr. Aldworth, who was witness of the fact which I last mentioned, at my desire ordered a small part of a meadow, near his seat at Stanlake, which had better grasses, and less mixed, than the rest, to be left unmowed till the seeds were fit for gathering. This piece yielded, upon threshing and sifting, a full bushel by measure of almost pure seed of the crested dog-tail.

" In case any one should be inclined to follow this example, I think it highly necessary to observe, that care must be taken to mow the grass before it sheds; that it be mowed very early in the morning, before the dew is off the ground, and that it ought not to be spread, as in making hay, but left as it falls from the

“ scythe during a sufficient time, and then be gently turned over.

“ The number of grasses fit for the farmer is, I believe, very small: perhaps half a dozen, or half a score, are all he need to cultivate; and how small the trouble would be of collecting the seeds of these, and how great the benefit, must be obvious to every one at first sight.—Would not any one be looked upon as wild, who should sow wheat, barley, oats, rye, peas, beans, vetches, buck-wheat, turneps, and weeds of all sorts, together? Yet how is it much less absurd to do what is equivalent in relation to grasses? does it not import the farmer to have good hay and grass in plenty? and will cattle thrive equally on all sorts of food? We know the contrary. Horses will scarcely eat hay that will do well enough for oxen and cows. Sheep are particularly fond of one sort of grass, and fatten upon it faster, than on any other, in Sweden, if we believe Linnæus. And may they not do the same in England? How shall we know, till we have tried? Nor can we say, that what is valuable in Sweden, may be inferior to many other grasses in England; since it appears, by the *Flora Suecica*, that they have all the good ones that we have. But however this may be, I should rather choose to make experiments, than conjectures.”

The illustrious Society for promoting Agriculture, &c. in the province of Britany, has laid down the most rational plan yet formed by any body of men, nobly associated for the welfare of their country; and which promises the greatest advantages to mankind. A part of this plan is, the

§ *Crops d' Observations de la Societè d'Agriculture, de Commerce, et des Arts. établie par les Etats de Bretagne.* Art. AGRICULTURE.

cul-

cultivating separately most of the plants which grow naturally in the fields there, in order to know which of them will afford the most, and the best, food for cattle.

As the husbandman would not be benefited by knowing the particular classes, genera, &c. under which Ray, Linnæus, and other botanists have ranged the several species of grasses; I shall here content myself with giving the names of such of them as may be cultivated to most advantage in this country, with the best drawings (for which we are indebted to Mr. Stillingfleet) of some of the most profitable sorts, which it will be of service to the farmer to be able to distinguish rightly.

The *common Dogs grass*, *Quick grass*, or *Couch grass* (*Gramen spicâ triticeâ repens vulgare, caninum dictum*^h) common creeping grass with a spike like wheat, called Dogs grassⁱ, will thrive in almost any soil, and can scarcely be got out again after it has once taken possession: so greatly does it multiply by it's roots and trailing branches, which put forth roots and shoots at every joint. It grows to the height of four or five feet, with blades so rough and coarse, that few horses will eat them, especially while they are green: but it yields abundant crops of hay, which does well enough for oxen, and therefore deserves, perhaps, more attention than our farmers have yet bestowed upon it. M. Duhamel indicates the best way of making the most of it, when he directs^k the farmer always to mow it before it's seeds ripen, or it's stalks grow hard; for after that, cattle refuse it: adding, that it soon shoots up again, and will bear frequent cutting.

^h RAII *Synopsis Stirpium Britannicarum*, p. 390. Edit. 3.

ⁱ MILLER'S *Gardener's Dict.* ART. GRAMEN.

^k *Eléments d'Agriculture*, Tom. II. Liv. 9. c. 2. art. 2.

This plant is well known to all husbandmen, to whom it is a sad plague when it gets into their arable land. It is the *chiendent* of the French; who, I must observe here for the benefit of their husbandry, do not distinguish it sufficiently from our

Rye-grass, which is C. Bauhin's *Gramen loliaceum, angustiore folio, et spica*, Darnel grass with a narrower leaf and spike; and Linnæus's *Lolium spicâ, muticâ*, Darnel with a chaffy spike: for darnel grass, rye grass, and ray grass, are only different names of one and the same plant: though M. Duhamel, misled by the erroneous spelling of some writers, who have called rye grass, ray grass, has been mistakenly induced to think that these are two different plants with us^l. We distinguish, indeed, two considerably different species of the rye grass, *viz.* the foregoing, which, according to Mr. Ray, is the *Lolium rubrum*, or *red darnel*; and the *Lolium album*, which, according to the same author, is C. Bauhin's *Gramen loliaceum spicâ longiore*, Darnel grass with a longer spike, and the *Yercaie* of the French, by us commonly called *darnel* only. But both of them are equally rye grass. It is the last of these species, *viz.* the *Lolium album*^m, which is chiefly cultivated in England, especially in strong cold land, upon which it will succeed better than any other species, and is an earlier feed in the springⁿ: but it is very coarse, and unless it be cut quite early for hay, it becomes so hard and wirey in the stalks, that few cattle care to eat it: for this sort of grass has but few leaves, and runs all to stalks. When cattle have been turned in to feed upon it, the remaining stalks, or *bents*, as they

^l *Ubi supra.*

^m RAIL, *Hist. Plant*, p. 1262, & *Synops*, p. 395.

Miller's *Gardener's Dict.* ART. GRAMEN.

are sometimes called, should be mowed off in June; for otherwise they will dry upon the ground, give the pasture the disagreeable appearance of a stubble field during all the latter part of summer, and be so very troublesome to the cattle which feed on it, by tickling their nostrils, that nothing but the want of better grazing will compel them to eat of the young grass which shoots up between these withered stems; for they will not eat them. Those who think that they do, when frightened for food, are greatly mistaken; according to Mr. Miller, who says, that he has closely attended to this many years, and has always found these bents remaining on the ground untouched, till the frosts, rain, and winds, have destroyed them in the winter. Besides this, by permitting them to stand, the after growth of the grass is greatly retarded, and the beautiful verdure of the fields is lost for three or four months. It therefore is good husbandry to mow them close to the ground, before they become too dry: and if this cutting is then made into hay, it will serve to feed cart horses in the winter, so as to repay the expence of moving.

The red darnel is a considerably inferior species of rye grass: for it has yet narrower leaves, and it's stalks grow hard much sooner. It is very common in most pasture grounds; because it flowers early, and it's seeds ripen and sow themselves before the hay is cut. They, therefore, who would keep their pastures as clear as possible from this grass, should always mow them before it's seeds are ripe.

Rye grass is usually sown with clover, upon such lands as are designed to be plowed again in a few years; and a common method is to sow it with spring corn. But Mr. Miller, from many repeated trials, has always found, that when this grass has

been sown in August, and a few showers have fallen shortly after, the crop has been by much the best: for it then has often been so high as to afford a good feed the same autumn: and a ton and a half of hay has been mowed early the next spring off each acre of land, though it has been a cold and sour soil. "I am therefore, says he, convinced of that being the best season for sowing these grasses; though it will be very difficult to persuade these persons to alter their practice, who have been long wedded to old customs. The quantity of seeds which I allow to an acre is about two bushels, and eight pounds of the common clover, which, together, will make as good a covering upon the ground as can be desired. But this is not to be practised upon lands where the beauty of the verdure is principally regarded. It is fittest for those who have only profit in view."—However, we must reckon as an abatement of this profit, that, as M. Duhamel rightly observes, the ground that has been under rye grass, which is not so profitable a crop as either lucerne, sainfoin, or even clover, is not able to bear wheat the next year; as it is after those other plants, or after a crop of roots.

According to Mr. Lisle's information^o, the farmers in the isle of Wight prefer rye grass to hop clover, because, say they, the rye grass will bear the winter, and keep to a good head, which the clover will not do. One of his tenants there had an acre and a half of rye grass upon tolerably good ground, which he shut up from Michaelmas till within a month of Candlemas, and from thence to the middle of April it kept fifteen ewes and fifteen lambs,

^o *Observations in Husbandry*, Vol. II, p. 57. art. GRASSES § 48.

Rye grass seldom lasts more than three years, as it is commonly managed: But Mr. Lisle is strongly of opinion, that, considering the nature of it's roots, and it's manner of propagating itself by sending forth fibres from it's joints, it may be kept alive many years longer, by dunging it, or by refreshing it with soil, when it begins to decay, after the second or third year: besides which, this will make its roots tiller, and mat on the ground, to the utter suppression and destruction of all weeds, not excepting even the couch grass.

An acquaintance of his near Upcurn, in Dorsetshire, told him that he had as much rye grass seed on eighteen acres of land, as was worth twenty pounds; and that, after the seed was threshed out, that hay was better than oat-straw fodder.—Mr. Lisle himself saw a rick of this coarse stubbed hay, and a rick of oat straw, both of which had been laid open to the cattle, in the same place; and they would not touch the straw, but had made such a hole in the rye grass hay rick, that it was ready to fall. The same person assured Mr. Lisle, that he found the rye grass to be excellent food for his cattle, if it was mowed green, and not kept for the lucre of the seed. His usual allowance was three bushels of this seed to an acre of land, and he used to sell it for twenty two pence, or two shillings, a bushel.

Another farmer shewed Mr. Lisle some of his rye grass, saying, that he looked upon it as his choicest fodder for sheep. He mowed it when in the flower; and Mr. Lisle declares, that he thought it very fine hay.—Others again, and those men of experience, have affirmed, that the very stubble of the rye grass, mowed the same year it was sowed is, when plowed in, as good as dunging, and will pay for the seed.

Mr.

Mr. Lisle agrees with all other experienced husbandmen, that, though rye grass will maintain as many cattle on an acre as hop clover will do; yet it does not, like it, improve the land for a subsequent crop of corn: the reason of which he takes to be, that the roots of the rye grass, consisting of a multitude of matty fibres, which run on the surface of the ground, gird and hold the earth so strongly together, that they cannot easily be disentangled from it by plowing.

“ If I may judge of this grass, says Mr. Stillingfleet P, by the venison I have eaten out of a paddock that was chiefly filled with this species, I would by no means recommend it for parks. I know it will be said, that venison is never good out of a paddock, that the deer must have room to range, trees to browse on, &c. I grant there is some reason for saying this, but I believe in general it is more owing to the want of proper food, viz. good grass, than merely to confinement: for paddocks are generally made out of a rich spot of ground near the house, that has constantly been manured, and of course is full of grass fitter for the dairy or the stable, than for deer; which hardly ever is the case in large parks. No man will, I suppose, pretend to make good pork from a hog fed with grains instead of peas, though he has the liberty of choosing as much ground as he pleases and where he pleases.”

In a subsequent edition of his Observations on Grasses, he adds: “ I have since eaten venison out of a large park, where there was much of this grass, and it was no better than that out of the paddock. I should be apt to think from hence, that this grass would not be proper for sheep,

“ as I have always observed that the same kind of
 “ ground which yields good venison, yields also
 “ good mutton. For what particular uses it is
 “ good, wants to be tried; whether for the dairy,
 “ for fattening cattle, or for horses. Many are
 “ tempted, by the facility of procuring the seed
 “ of this grass, to lay down with it grounds near
 “ their houses, where they want to have a fine
 “ turf: but, unless the soil be very rich, a worse
 “ grass cannot be chosen for this purpose, as it will
 “ certainly die off entirely in a very few years.”

The *Wall barley*, or *way bennet*, as some people improperly term it, is evidently, from the shape of it's ear, and from every other characterising circumstance, a *rye grass*, or *wild rye*, as Mr. Ray observes^q; though very different from the preceding. It is the *Gramen secalinum et secale sylvestre*^t, called *tall meadow rye grass* by Mr. Miller^s, who reckons it an excellent grass for sowing, because it is very leafy, it's stalks do not become stiff and hard like many other species, and it's roots are perennial. He seems not to doubt but that it may be rendered very fine by proper care; and as it's roots are perennial, rolling will make them mat, so as to form a very close sward. There are three sorts of it, *viz.* the greater, the lesser, and the marsh rye grass. Mr. Stillingfleet wishes that this genus only were to be called *rye grass*, and that the old name of *darnel* were continued to the *Gramen loliaceum*, or *rye grass*, before spoken of.

The two best species of grass for pastures are, in Mr. Miller's opinion^t, C. Bauhin's *Gramen pratense*, *paniculatum majus*, *angustiore folio*, meadow grass, with large panicles, and a narrower leaf, which is the *Poa paniculâ diffusâ*, *spiculis qua-*

^q *Hist. Plant.* p. 1258, and *Synops.* p. 391.

^r JOHNSON, *ap.* Gerardum.

^s *Gardener's Dict.* Art. GRAMEN.

^t *Ibid.*

drifloribus

trifloribus pubescentibus culmo erecto teretri, Flor. Suec. 77. *Poa* with a diffused panicle, the smaller spikes having four hairy flowers, and a taper erect straw; and C. Bauhin's *Gramen pratense, paniculatum majus, latiore folio*, Meadow grass, with a larger panicle, and broader leaf, which is the *Poa paniculâ diffusâ, spiculis trifloribus glabris, culmo erecto teretri*, Flor. Suec. 76. *Poa* with a diffused panicle, small spikes with three flowers, and an upright straw.

I take these to be the *Great Meadow Grasses* represented in *Plate III. Fig. 1*, for which I am indebted to Mr. Stillingfleet, and which, as he observes, are common in our best meadow grounds. He has also met with them frequently on banks by the road side, and near ditches, even where they were not to be found in the adjoining meadows and pastures. But as he has not favoured us with a botanical description of them, I can only form conjectures.

If the seeds of these two sorts were carefully collected, and sown separately, without any mixture of the seed of other grass, they would not only afford a greater quantity of fodder on the same space of land, but the grass would also be better, the hay sweeter, and the verdure more lasting, than that of any other species. Mr. Miller recommends this particularly to every gentleman who would improve the verdure near his habitation.

The *annual Meadow Grass* (*Pl. III. Fig. 2*) makes the finest of turfs. It grows every where by way sides, and on rich found commons. It is called in some parts the *Suffolk grass*, as I mentioned before. Mr. Stillingfleet says "he has seen whole fields of it in High Suffolk without any mixture of other

▪ *Miscellaneous Tracts*, p. 383.

grasses, and as some of the best salt butter we have in London comes from that country, it is most likely to be the best grass for the dairy. He adds, in relation to this grass, a remark he made on Malvern hill, where a walk that was made for the convenience of the water drinkers was covered with it in many places in less than a year, though he could not find a single plant of it besides in any other part of the hill. This was, doubtless, owing to the frequent treading, which, above all things, makes this grass flourish; and therefore it is evident that rolling must be very serviceable to it. As the flowers and stems of this plant do not grow brown so soon as those of other grasses, nor do they cover the radical leaves so much, because they are considerably shorter, this affords a more pleasing turf than any other grass.

M. Ray observes * of the common meadow grass, that it is a slender and succulent plant, very agreeable to cattle, and a fattener of them; that it delights in a rich soil; and that it is not injured by being trodden under foot, and therefore it is common along the sides of paths and roads. It spindles and ears in the spring; and continues to shoot during the whole summer.

As the next best to meadow grass, Mr. Miller recommends † Ray's *Gramen avenaceum pratense elatius, paniculâ flavescente, locustis parvis* ‡, Taller meadow Oat-grass, with a yellowish pannicle, and small husks; which is the *Avena paniculâ laxâ, calycibus trifloris brevibus, flosculis omnibus aristatis*. Prod. Leyd. 66. Oat-grass with a loose panicle, three flowers in each empalement, which is short,

* Hist. Plant. p. 1284.

† Gardener's Dict. Art. GRAMEN.

‡ RAIL Hist. ubi supra; and Synops. p. 407.

and all the flowers having awns*. Mr. Ray likewise recommends ^a the *smooth mountain Oat-grass* (Pl. III. Fig. 3), which he calls *Gramen avenaceum montanum spicâ simplici, aristis recurvis*, found by Mr. Dale, upon Bartlow hills in Essex, on the edge of Cambridgeshire, in the borders of the corn fields between Newmarket and Exning, and on the chalk hills between Northfleet and Gravesend; and the *rough, or hairy Oat-grass* (Pl. III. Fig. 4.), which he distinguishes by the appellation of *Gramen avenaceum hirsutum, paniculâ purpuro-argenteâ splendente*, and which abounds in the pastures about the Earl of Cardigan's house at Twittenham in Middlesex. He also includes under this genus ^b, all the *festuca* kinds, of which Mr. Stillingfleet gives the following account, in his observation on Grasses, subjoined to his translations of several ingenious tracts selected from the Transactions of the Academy of Upsal.

Sheeps fescue (Pl. III. Fig. 5.), which he distinguishes by the name of *festuca ovina*, is the grass most esteemed for the food of sheep in Sweden, where they have not such downs as we have.

^a *Synops.* p. 405. 406.

^b *Hist. Plant.* p. 1289; and *Synops.* p. 413.

^c Page 384 and seqq.

* The *festuca avenacea hirsuta, paniculis minus sparsis*. Rough oat-grass (or *Drank*) with more compact panicles ^g, grows on walls and hillocks, and on linchets or baulks in fields, and is what our country people commonly call *lob-grass*, or *hooded-grass*. Mr. Lisle says ^h that this is the *fromental* of the French, and adds, that it is apparently of but little value; for it grows up in a single culm from a root, without grassy leaves, or herbage, about it's roots. As it generally grows on the poorest sort of ground, we need not wonder that so much of it's seeds is commonly seen among the rye-grass seed that is sold; I suspect it to be but an annual plant. Our husbandmen endeavour rather to destroy, than propagate it.

^g *Rail Synops.* p. 413.

^h *Observations in Husbandry, Vol. II.* p. 72.

Gmelin says^d, that the Tartars choose to fix during the summer in those places where there is the greatest plenty of this grass; because it affords a most wholesome nourishment to all kinds of cattle, but chiefly sheep: and he observes, that the sepulchral monuments of the antient Tartars are mostly found in places which abound with this grass; which shews, adds he, that it has long been valued among them.

This grass abounds in many parts of England and Wales, and particularly on all the finest sheep pastures in Herefordshire, Oxfordshire, Norfolk, &c^e. Mr. Stillingfleet observes, that it is a very early grass, and that, contrary to what Linnæus says, either sheep or some other animals do eat the flowering stems of this grass; for when he searched for it upon Banstead downs, he could see no part of it but the radical leaves, except among bushes, near the hedges, where it was guarded from the sheep.

Mr. Stillingfleet says, that he has always seen the *purple fescue* (Pl. III. Fig. 6) along with the *fine bent* and *silver hair-grass*, which will be spoken of hereafter, particularly on Bansted downs, in great plenty, in a place inclosed in order to keep the sheep out. From thence he is inclined to think, that this is the chief grass all over the downs: but as the flowering stems in the other parts were intirely gone at the time of his viewing it, except along the hedges, he could not be certain in this respect.

After candidly declaring his want of knowledge of the qualities of the *stote fescue* (Pl. III. Fig. 7) which he calls *Festuca fluitans* †, Mr. Stillingfleet quotes

^d *Flor. Sibiric.*

^e STILLINGFLEET, *ubi supra*, p. 385.

† There is a species of *stote-grass* which Mr. Ray calls *Gramen aquaticum geniculatum spicatum*, spiked stote grass. It grows in

quotes a curious passage in the Transactions of the Academy of Upsal^f, where the author of a piece entitled *Plantæ Esculentæ* says, that the seeds of this grass are gathered yearly in Poland, and from thence carried into Germany, and sometimes into Sweden, and sold under the name of *manna* seeds^{*}; and that they are there much used at the tables of the great, on account of their nourishing quality and agreeable taste.—Mr. Stillingfleet then adds, that one Mr. Dean, a very sensible farmer at Ruscomb, in Berkshire, assured him, “ that a field of about four acres, which always lay under water, and was occupied by his father when he was a boy, was covered with a kind of grass that maintained five farm-horses, in good heart, from April to the end of harvest, without giving them any other kind of food, and that it yielded more than they could eat. Some of it was carried to Mr. Stillingfleet, who found it to be the *flote fescue*, with a mixture of the *marsh bent*: but whether this last contributes much towards furnishing so good pasture for horses, seems doubtful to him. They both throw out roots at the joints of the stalks, and are therefore likely to grow to a great length.

Linnaeus says^g, that the bran of this grass will cure horses troubled with bots, if they are kept from drinking for some hours.

in watery places, multiplies immensely, and has exceeding long trailing stalks, which, like the sort mentioned by Mr. Stillingfleet, put forth roots at their very numerous joints, and do not rise much in height. *Hist. Plant. p. 1264.*

* There is a clamminess on the ear of the *flote fescue*, when it's seeds are ripe, which tastes like honey, as Mr. Stillingfleet says he has often found; and for this reason, perhaps, they are called manna seeds.

^f *Amœnit. Academ. Tom. III.*

^g *Flor. Suec. art. 95.*

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In the index of dubious plants at the end of Ray's *Synopsis*, mention is made of a grass called *Gramen caninum supinum longissimum*, longest supine Dog's grass, which grows at Maddington in Wiltshire, and in some parts of Wales, to the length of twenty four feet, and is used for the fattening of hogs. It's stalks are of the creeping kind, and touch the ground at several of their knots; for they do not rise much in height. Mr. Stillingfleet thinks it the *stote fescue*, and rightly advises farther inquiries concerning it. But he does not seem here to have consulted Mr. Worlidge, who says^b, speaking of this grass, that it is extraordinarily sweet, but not so easily propagated as has been imagined: the length thereof being occasioned by the washing of a declining sheep-down from whence hasty rains bring with them much of the fatness of the dung of the sheep, which subsides upon the small meadows where this grass grows: so that in springs not subject to these showers, or on lands not enriched by that fertilising soil brought down to them, this grass does not thrive so well.

The *Vernal grass* (*Pl. III. Fig. 8*) which Mr. Stillingfleet calls *Anthoxanthum odoratum*, and which is at least a species of Ray's *Gramen vernum spica brevi laxa*ⁱ, and of C. Bauhin's *Gramen vernum pratense spica flavescens*^k, Vernal grass with a loose yellowish spike, is one of the earliest grasses, and grows very commonly in all our meadows, pastures, and other grounds. It is found in plenty upon those pastures which sheep are fond of, and from whence excellent mutton comes; and therefore it is most likely to be a good grass for sheep pastures; Mr. Stillingfleet says, he has found it on

^b *Systema Agriculturae*, p. 32.

ⁱ *Hist. Plant.* p. 1268, and *Synop. Stirp. Brit.* p. 398.

^k *Pin.* 3. *Tb.* 44.

all kinds of grounds, from the most sandy and dry to the most stiff and moist, and even in bogs. It is very plentiful in the best meadows about London. viz. towards Hampstead and Hendon; and it's seeds may be gathered very easily, as it sheds them upon the least rubbing. This grass gives a grateful odour to hay.

Mr. Lisle remarks¹, that the *Gramen parvum repens purpureâ spicâ*, small creeping grass with a purple spike, is no indication of bad ground, though it be a very bad grass. Ray says^m, that it is very common in pastures—There seems to be a great sweetness in it.—The same may be said of the *gramen cristatum*, or smooth crested grass, which also abounds every where in our meadows and pasturesⁿ.

The meadow fox-tail grass, (Pl. III. Fig. 9.) *Gramen alopecuroides*^o, abounds in our best meadows about London, and makes very good hay: perhaps the best of any that is brought to market here. Mr. Stillingfleet observed in the spring of last year (1762,) a meadow near Hampstead, which consisted of this grass chiefly, with some of the vernal grass and the corn brome grass: but it is scarce in many parts of England, particularly in Herefordshire, Berkshire, and Norfolk; though it might be gathered at almost any time of the year, even from hay-ricks, as it does not shed it's seeds without rubbing, which is the case of but few grasses.

The water fox-tail (*Alopecuroides paludosum*^p) is also found in such meadows about London as are found and lie under water in the winter. Mr. Stil-

¹ Observations in Husbandry, Vol. II. p. 38.

^m Hist. Plant. p. 1286.

ⁿ Ibid. p. 1289. and Synops. p. 398.

^o Ibid. p. 1296. and 396.

^p RAIL, Hist. Plant. p. 1266.

lingfleet thinks it may, perhaps, be a proper grass to sow on such grounds.

Mr. Stillingsfleet has always found the fine *bent* grass (*Pl. III. Fig. 10*), which he names *Agrostis capillaris*, in great plenty on the best sheep pastures, as on Malvern hills, Bagshot heath, and all the high grounds in Herefordshire, Berkshire, Oxfordshire, and Norfolk, and other places remarkable for good mutton.

The same may be said of the *mountain Hair grass* (*Pl. III. Fig. 11*), which he calls *Aira flexuosa*; and of the *Silver Hair grass* (*Pl. III. Fig. 12*), which is his *Aira Caryophyllæa*.

The *quaking grass*, *Cow-quake*, or *Lady's Hair*, as it is called in some places, is the *Gramen tremulum maximum*, of C. Bauhin^q, and J. Ray^r, and the *Briza spiculis cordatis, flosculis septendecim*, Hort. Cliff. 23. *Briza* with heart-shaped little spikes, and seventeen flowers in each. Though a very poor and slender grass, Mr. Lisse thinks it no indication of poor land where it grows: for, as Mr. Ray observes, it is the most common grass of any in all the pasture grounds throughout England.

Mr. Miller describes it^t as having an annual root, which sends up many broad hairy leaves, between which arise slender stiff stalks, from a foot to near two feet high, dividing upward into a large loose panicle, garnished with heart-shaped small spikes, each having about seventeen small floscules or florets; and these, after the flowers are past, are succeeded by a single seed. The heads hang by slender long foot-stalks, which are moved by every wind, so that they generally appear shaking; from whence it had the name of *quaking-*

^q Note p. 2.

^r *Hist. p.* 1274; and *Synops. p.* 412.

^t *Observations in Husbandry, Vol. II. p.* 37.

Gardner's *Dict. Art. GRAMEN.*

grafs. There is a smaller species of it, which is a native of England; but, I believe, of no greater value than the former. These grasses come to head in May: and this gave rise to the English Proverb, *May, come she early come she late, makes the Cow quake.*

Matweed, (*Gramen Sparteum*) is of the broom kind, and delights in sandy places, near the sea. Even clouds of sand blown over it do not hurt, but, on the contrary, promote, it's growth. It has been of excellent service in fixing loose sands, as, if I have been rightly informed, it once did very remarkabiy in Norfolk. Of ten species of this plant, which Mr. Ray distinguishes^u, the following are the chief. 1, *Spartum Plinii*, five *Juncus Hispanicus*, the true matweed of Pliny, or Spanish broom; 2, *Gramen sparteum panicula brevi folliculo inclusa*, Hooded matweed; 3, *Gramen sparteum marinum Anglicanum*, English sea mat-weed, or marram; 4, *Spartum maximum maritimum Hollandicum*, *spica scabina* the greatest Holland matweed, with a rye spike; 5, *Gramen sparteum pennatum*, Feather grass; and 6, the *Gramen sparteum juncifolium*, or *spartum parvum*, small matweed.

Mr. Stillingfleet says, that the best mutton be ever tasted, next to that which comes from hills where the purple and sheep's fescue, the fine bent, and the silver hair grasses abound, was fed upon the *crested dog-tail grass* (*Pl. III. Fig. 13*), which he and Mr. Hudson call *Cynosurus cristatus*. He therefore rightly judges it proper for parks; and confirms this opinion, by adding, that he knows a park where this grass abounds, which is famous for excellent venison.—It makes a very fine turf upon dry, sandy, or chalky soils: but unless it be swept over with the scythe, it's flowering stems

^u *Hist. Plant. p. 1259, et seqq.*

Fig. 1.



Fig. 2.



Fig. 3.



Fig.



Great Meadow Grass. Annual Meadow Grass. Smooth Oat Grass.

Fig. 4.



Fig. 5.



Fig. 6.



Fig. 7.



Grass. Hairy Oat Grass. Sheep's Fescue Purple Fescue Flote Fescue Vernal
Grass. Grass. Grass.

Fig. 5.

Fig. 6.

Fig. 7.

Fig. 8.

Fig.



Grass. Sheeps Fescue Purple Fescue Flote Fescue Vernal Grass. Meadow
Grass. Grass. Grass. tail

Fig. 9.

Fig. 10.

Fig. 11.

Fig. 12.

Fig. 13.



Meadow Fox-tail Grass. Fine Bent Grass. Mountain Hair Grass.

Silver Hair Grass.

Crested Dog-tail Grass.

will look brown; as is the case of all grasses which are not fed by a variety of animals: for that some animals will eat the flowering stems, is evident from commons, where one scarcely sees any part of the grasses, except the radical leaves.

Mr. Miller thinks the *cock's-foot grass* (Ray's *Gramen dactylon*, Hist. p. 1271), the *Capon's tail grass* (Ray's *Gramen murorum spicâ longissimâ*, Hist. p. 1286), and the *millet grasses* (*Gramina miliacea*), too coarse to deserve attention in England; though some of their species are very useful in the warm parts of America, where there is a great scarcity of finer grass, and even much better adapted for such climates, than any of our European grasses; because many of them lie flat on the ground, and emit roots from their joints, by which means they are well prepared for heat; of which their large and juicy stalks likewise enable them to bear an extraordinary degree.

The purple, or, as it is commonly called *red meadow trefoil*, which is C. Bauhin's *Trifolium pratense purpureum*, has already been sufficiently distinguished* from the common red clover, or red honeysuckle (Ray's *Trifolium purpureum majus, pratense simile*, Syn. 328.), which, though Mr. Lisle thinks otherwise^a, is undoubtedly a native of England, as is manifest from it's spontaneous and flourishing growth on the top of many mountains, particularly in even the most northern parts of Scotland, where no mortal surely ever dreamt of cultivating it. The species called yellow meadow trefoil, or hop-clover, is C. Bauhin's *Trifolium pratense luteum, capitulo lupuli, vel agrarium*; and the smaller kind of this, commonly called none-such, or black-seed, is the *Trifolium luteum, lupulinum*,

* See p. 202.

^a *Observations in Husbandry*, Vol. II. p. 40.

minimum. M. Duhamel^b rightly prefers the first of these sorts for artificial pastures, and observes that it is the only species now cultivated in France, for that purpose.

Our meadows affords us the white meadow trefoil, honeysuckle grass, or white Dutch clover, which is the *Trifolium pratense album* of C. Bauhin, and by far the best sort of clover for lasting pastures, because it is the sweetest and most abiding of all the plants of this kind.

This white clover, besides being perennial, sends forth roots and shoots from every joint of it's trailing branches, for it does not rise high, and thereby forms the closest sward of any of the artificial grasses. It is exceeding sweet food for all sorts of cattle: for which reason a quantity of the seeds of this plant should always be sown with the other grass seeds, on whatever land is intended to be laid down for pasture. The usual allowance of this seed is eight pounds to an acre. But it never should be sown with corn; because this will weaken it, so that it will be scarcely worth standing. And yet, as Mr. Miller observes^c, such is the covetousness of most farmers, that they will not be prevailed on to alter their old custom of laying down their ground with a crop of corn, though they lose twice the value of that corn, by the poorness of the grass, which will not then come to a good sward: and one whole season is also lost: for if this seed is sown in the spring, without corn, there will be a crop of hay to mow by the middle, or latter end of July, and a much better after-feed for cattle the following autumn and winter, than the grass which is sown with corn will produce the second year. It may also be

^b *Eléments d'Agriculture*, Tom. II. p. 141.

^c *Gardener's Dict.* Art. TRIFOLIUM.

sown with grafs seed in autumn, in the manner before directed^d for the common red clover; and if the seeds grow kindly, this autumnal sowing will afford a good early crop of hay the following spring. If the ground is well rolled after this crop is taken off, the clover will mat close upon it, and form a thick sward.

Considerable quantities of the seeds of this white clover are imported hither annually from Flanders, by the way of Holland; from whence it has received the name of *Dutch* clover: not that it is more a native of that country, than of this; for it is very common in the pastures all over England; but the seeds of it were never collected here, for sowing, till of late years; nor are there yet many persons in this kingdom who save them, though they may be saved with the same ease, and in the same manner, as is practised for the red clover. Every farmer who would improve his land, should therefore sow an acre or two with this white clover, unmixed, merely for the sake of it's seeds, which are often sold at a great price. He will by this means save the expence of buying them; and he will easily find purchasers for any quantity he may have to spare.

I do not know that the narrow leaved plantain, or *ribwort*, (*Plantago angustifolia*) hath ever been cultivated purposely for the food of cattle. It grows, indeed, in almost all pastures: but, as it will thrive upon very dry spots, because it strikes a deep root, it may probably deserve farther trial.

The reverend Dr. Eliot, whom I ought not to mention without paying a just tribute of respect to his memory, recommends two sorts of grasses, natives of North America, of which he lately sent over a parcel of the seeds to the London Society

for the Encouragement of Arts, &c. by whom they have been distributed here, so that we may hope soon to know their success in this country, and of which he has given the following account in his *Essays upon Field-Husbandry in New England*^e.

“ One of these grasses is called *Herd-grass*, from one Herd, who first discovered it in a marsh in Piscataqua, and afterwards propagated it; and “ it is likewise called *Timothy-grass*, from the name “ of the person who first propagated it in Pensylvania. The other, which is termed *Fowl-meadow-grass*, was brought into a piece of poor “ meadow in Dedham, by ducks and other wild “ water-fowls; from whence it is called by this “ odd name. It is supposed to be brought into the “ meadows at Hertford by the annual floods, and “ is there called *Swamp-wire-grass*. Of these two “ sorts of natural grass, the *fowl-grass* is much “ the best. It grows tall and thick, and makes a “ softer and more pliable hay, than *herd-grass*, “ and consequently will be fitter for pressing, in “ order to ship off with our horses: besides which, “ it is a good grass, and yields a good burthen, “ viz. three loads to the acre. It must be sowed “ in low moist land. Our drained land, when it “ is of sufficient age, is very agreeable to this sort “ of grass. As the seed is very fine, there is “ danger of sowing it too thick, as some have “ done, so as to come up thick like hair. This is “ a loss of seed, and prejudicial to the grass.

“ When you bring to a swamp by flowing, “ have killed your brush, ditched your land, and “ got it a little dry, you may sow your seed “ among the trees and brush: it will come up, “ establish itself, and prevent other bad grass from

“ taking possession: then you may clear off
 “ the wood and brush at your leisure, and you
 “ will have good grass to mow as fast as you can
 “ clear the land. I have seen it grow knee-high,
 “ when the dead brush was very thick.

“ This grass has another good quality, which
 “ renders it very valuable in a country where help
 “ is so much wanting: this is, that it will not
 “ spoil or suffer, although it stands beyond the
 “ common time for moving. Clover will be lost
 “ in a great measure, if it be not cut in the pro-
 “ per season; and rye-grass, which we commonly
 “ call English grass, will be little better than rye
 “ straw, if it stands too long: but this fowl grass
 “ may be mowed at any time, from July to
 “ October.—This I wondered at: but viewing
 “ some of it attentively, I think I have found the
 “ reason of it. When it is grown about three
 “ feet high, it then falls down, but doth not rot
 “ like other grass when lodged; and in a little
 “ time after it is thus fallen down, it puts forth a
 “ new branch at every joint. Now to maintain
 “ this young brood of succors, a plentiful course
 “ of sap must be conveyed up through the main
 “ stem, or straw; and by this means the grass is
 “ kept green, and fit for mowing, during all this
 “ long period.—I find by experience, that the
 “ best time to mow it, is when these new branches,
 “ or succors, have attained to their full growth.

“ One of my sons told me, that, at New-Fair-
 “ field, he saw some stalks of it, which the people
 “ told him was cut in October. He pulled out
 “ some of the hay: it looked green, and had a
 “ good smell. This is a great convenience in time
 “ of sickness, or any other casualty, whereby we
 “ may be hindered from mowing in season.

“ This good property renders it a fit sort of
 “ grass for a new country, where we often have
 “ business

“ business crowd too hard upon us.—It is so
 “ peculiarly agreeable to deer, that they prefer
 “ it to every other food, not excepting even corn.”

HAVING now described the several sorts of
 grasses fittest for pasture, I cannot but join with
 Mr. Miller, when he remarks ^f, that “ there is no
 “ part of husbandry, of which the farmers are,
 “ in general, more ignorant, than of this. Most
 “ of them suppose, that when an old pasture is
 “ plowed up, it can never be brought to have a
 “ good sward again: so their common method
 “ of managing their land after plowing, and get-
 “ ting two or three crops of corn, is to sow with
 “ their crop of barley, some grass seeds (as they
 “ call them); that is, either the red clover, which
 “ they intend to stand two years after the corn is
 “ taken off the ground, or rye-grass mixed with
 “ trefoil; but as all these are at most but biennial
 “ plants, whose roots decay soon after their seeds
 “ are perfected; so the ground, having no crop
 “ upon it, is again plowed for corn: and this is
 “ the constant round which the lands are employ-
 “ ed in, by the better sort of farmers; for I have
 “ never met with one of them, who had the least
 “ notion of laying down their land to grass for
 “ any long continuance: therefore the seeds
 “ which they usually sow, are the best adapted
 “ for this purpose.

“ But whatever may have been the practice of
 “ these people, I hope,” continues he, “ to prove,
 “ that it is possible to lay down land, which has
 “ been in tillage, with grass, in such manner as
 “ that the sward shall be as good, if not better,
 “ than any natural grass, and of as long duration.
 “ But this is never to be expected in the common
 “ method of sowing a crop of corn with the grass

^f *Gardener's Dict.* ART. PASTURE,

“ feed ; for wherever this has been practised, if the
 “ corn has succeeded well, the grass has been
 “ very poor and weak ; so that if the land has
 “ not been very good, the grass has scarcely been
 “ worth standing : for the following year it has
 “ produced but little hay ; and the year after, the
 “ crop is worth little, either to mow or feed : nor
 “ can it be expected it should be otherwise ; for
 “ the ground cannot nourish two crops.”

In consequence of this, Mr. Miller proceeds to give the following directions for the management of pasture land.

When ground is laid down for grass, no crop of any kind should be sown with the seeds, and the land should be well plowed, and cleaned from weeds. The best season to sow the grass-seeds, upon dry land, is about the middle of September, or sooner, if there be an appearance of rain ; because the ground being then warm, if some good showers of rain fall after the seed is sown, the grass will soon make it's appearance, and get sufficient rooting in the ground before winter, not to be in danger of being turned out by the frost ; especially if the ground is well rolled before the frost comes on. If the grass comes up well, this rolling should be performed towards the end of October, or the beginning of November, and repeated again in the beginning of March. The sward will, in this case, be closely joined at the bottom, and a good crop of hay may be expected the same summer. In cold lands, which lie very open and exposed, it will be right to sow the seeds a month earlier, that the grass may have time to get good rooting, before the cold season comes on to stop it's growth. If the ground cannot be prepared for sowing in autumn, it may be sowed in the middle or latter end of March, according as the season is early or late. The danger
of

of sowing late, is dry weather, especially if the soil be light and dry. It will then be proper to roll the ground well, soon after the seeds are sown; to settle the surface, and prevent it's being blown away, together with the seeds, as has frequently happened, by the high winds in March.

The farmer's judgment, if he attends to the above account of the best and most profitable sorts of grasses, will direct him sufficiently in his choice of seeds, and enable him to suit each particular species to it's proper soil. The quantity fittest to be sown, will depend on the nature of the seed; that is to say, on it's being light and chaffy, or on it's being naked; much more of the former being necessary, than of the latter. If it be intended to mix clover with the grass, the seeds of the clover should be sown alone, after those of the grass; because, as they are by much the heaviest, they would soon separate from the grass seeds, and sink to the bottom of them in the seed-man's apron, or whatever other vehicle he makes use of, and consequently would be sown unequally.

After the seeds are sown, the ground should be harrowed lightly to bury them: but this should be done with a short toothed harrow; for otherwise the seeds will be buried too deep. If the surface of the ground is dry, it should be rolled, two or three days after sowing, with a barley roller, to break the clods, and settle the ground; which will prevent the seeds from being removed by the wind.

When the seeds are come up, the ground should be weeded: otherwise the weeds will increase, so as to keep down the grass, and starve it: and if they are suffered to remain till they have shed their seeds, they will over-run the land, and entirely

tirely destroy the grass. One of the principal parts of husbandry, is never to suffer weeds to grow.

If the ground is rolled two or three times, at proper intervals, after the grass is up, this will make it form a thicker bottom: for as the white clover puts out roots from every joint of the stalks which are near the ground; the roots will mat so closely together, as to cover the whole surface of the ground with a sward capable of resisting any common drought.

After the ground has been brought to a good sward, the way to preserve it so, is to roll it constantly every spring and autumn, with a heavy roller, and to keep it clear from all sorts of weeds. Dressing of these pastures every third year, is also necessary; for otherwise it cannot be expected that this ground, which has not the benefit of tillage, should continue to produce good crops: and another thing proper to be observed, is to change the seasons of mowing, and not to mow the same ground every year; but to mow one season, and feed the next: for ground that is mowed every year will soon be exhausted, if it has not a constant supply of manure.

It is plainly owing to our farmers not distinguishing grasses which are annual, from those which are perennial, that land which has been in tillage is not brought to a good turf again, in the common method of husbandry: for annual and biennial grasses will soon decay, and nothing can be expected to succeed them, but what will grow naturally; except, perhaps, on some spots, where their seeds may chance to have ripened and sown themselves. This, added to the covetous method of laying down the ground with a crop of corn, has been the true cause of the decrease of pasture in many parts of England, where it is now much more valuable than arable land.

SECT.

S E C T. III.

Of the Improvement of Pastures already under Grass.

MANY excellent meadows and pasture grounds are so over-run with bushes, shrubs, weeds, mole hills, ant hills, and the like, that great part of them is oftentimes wholly lost, and a considerable portion of the remainder cannot be mowed but in patches, to the manifest detriment of the husbandman, whose first care, in such case, should be, the removing of these obstacles.

Mr. Platt's very good and easy directions for grubbing up shrubs and bushes, by means of a sufficiently large and strong dung-fork, driven into the ground, at about six inches distance from the root intended to be torn up, then raised by laying under it a stone or log of wood, and afterwards pulled down by a rope fastened to the upper end of it's handle, have been given in the first volume of this work *, and will be found effectual to wrench up whole bushes, with their roots.

The reverend Dr. Eliot advises, from his own experience, when any bushy growth is to be extirpated by cutting it down, always to choose for this business a cloudy day †, in June, July, or August; because the stumps will bleed more freely at such a time, and consequently die sooner, than when the hot rays of the sun shine upon them, and dry up the sap. He adds that *it should be in the old moon, on the day that the sign is in the heart*; and instances, in support of this, facts, which, ridiculed and exploded as all such notions now are, cannot be doubted, as he asserts them, however else they

* Page 221.

† *Essays on Field-husbandry in New England*, p. 16.

may be accounted for. — I shall give them in his own words; and leave to critics the office of carp-
ing at them; and to the modern learned to task
of disproving his reasons for what he relates, if
either of them should choose to take offence
thereat.

“ Last year, says he ^b, in June or July, I forget
“ which, I sent a man to make a trial. In going
“ to the place, some of the neighbours, under-
“ standing by him the nature of the business he
“ was going about, and the reason of his going
“ at that point of time, went also to their land,
“ and cut bushes also on that day. Theirs
“ were tall bushes, which had never been cut:
“ mine were short ones, which had been often
“ cut, but to no purpose, unless it was to increase
“ their number. The consequence was, that, in
“ every place, it killed so universally, that there is
“ not left alive, scarce one in an hundred. The
“ trial was made in three or four places, on that
“ same day. In July or August, on the critical
“ day, another swamp was cut; the brush was,
“ for the greatest part, swamp button wood, the
“ most difficult to subdue of any wood I know.
“ I have been lately to see it, and find the de-
“ struction of these bushes not so universal as
“ among alders and other sorts of growth. It is
“ hard to say how many of them remain alive: it
“ may be one third or a quarter part. All that I
“ can say, with certainty, is, that they are now
“ few, compared with what there was last year. I
“ did not know, but that those which are alive,
“ might be such as came up since: but, upon
“ examination, I found the last year’s stumps, and
“ could plainly see where they had been cut off.
“ This was not because the season was better when

^b *Ibid.* p. 123.

“ there

“ there was such success: for in this last mention-
“ ed piece of swamp, there were sundry spots of
“ alders and other sorts of bushes, and they seem to
“ be as universally killed as the others. The reason
“ why the same success did not attend the cutting
“ of the button bushes, as of the other sorts, I
“ suppose to be from the stubborn nature of this
“ kind, which would not yield to any cutting.
“ The ordinary way has been to dig or plow it
“ up by the roots: so that, considering the nature
“ of this bush, I have had great success. The
“ ground being very boggy, those who mowed
“ them were obliged to cut them very high, which
“ was another disadvantage.

“ To shew such a regard to the signs, may in-
“ cur the imputation of ignorance or supersti-
“ tion: for the learned know well enough, that
“ the division of the Zodiac into twelve signs,
“ and the appropriating these to the several parts
“ of the animal body, is not the work of nature,
“ but of art; contrived by astronomers, for con-
“ venience. It is also as well known, that the
“ moon’s attraction hath great influence on all
“ fluids.

“ It is likewise well known to farmers, that
“ there are seasons when bushes, if cut at such a
“ time, will universally die. A regard to the
“ sign, so far as it serveth to point out and di-
“ rect to the proper time, becomes therefore wor-
“ thy of observation.

“ A farmer of good credit told me, that he
“ had found by experience, that bushes cut with
“ a sharp tool will die sooner than when cut with
“ a dull one. This seems agreeable to reason:
“ for a sharp scythe leaves the mouths of the sap
“ vessels all open, by which means they bleed
“ more plentifully; but a dull instrument bruises
“ the

the part, and, in a degree, closes up the wound*.

"Elder bushes are stubborn, and hard to subdue: yet I know by experience, that mowing them five times in a year will kill them."

The trash thus rooted up, or cut down, but rooting of it up is by much the best way, should afterwards be dried and burnt, and the ashes proceeding therefrom will be of great service to the ground, if spread upon it just before the autumnal rains.

The way to remove mole-hills and ant-hills, which are not only disagreeable to the sight, but detrimental to the pasture, and a great hinderance to the mowing of the grass, especially where they are numerous, is, particularly in regard to the latter, either to divide the turf which grows over them, into three parts, with a spade, or other instrument, then to pare it off each way, to dig out the middle or core of the hills, to spread this mould over the other ground, to leave the holes open all the winter, that the ants may be killed, to lay the turf down again in the spring, and to roll those spots after the re-instated turfs are settled, and their grass has taken fresh root: or, which is a more expeditious method, to scoop them out at once, with what Mr. Bradley calls^d a scoloped mole-hill plough, made in the following manner.

From *a* to *a* (*Fig. 1. Plate IV.*) is an iron plate, about five inches over, and above an inch thick at the back, *bb* is the scoloped spade, or tongue, of the plough, and about a foot over at the widest part. This, from the sharp point, grows

* For a similar reason it is that gun-shot wounds never bleed so freely as those which are made with a sharp cutting instrument.

^c *Ibid.* p. 17.

^d *Complete body of Husbandry*, p. 47.

thicker by degrees, till it comes to the back, which should be a full inch thick. The iron must be well hardened, and very sharp at the edges. *cc* is the paring plate, which should be very sharp on the fore edge, and, with the scolloped spade, should be four feet long, from *a* to *a*. *dd* are iron sockets, in which are fixed the plough handles, or stils, *ee*. At *aa* are foot-links to set the harness on, for one horse, or two horses lengthwise, to draw by.

When this plough is used, the point of the scolloped spade must be set to the bottom of the hill, by raising the plough stils, so that it may go into the ground; and when the hill is near cut through, the point should be raised up again, by weighing a little on the stils.

The hollow left by this plough will receive the rain as it falls, and this will drown the remaining ants.

After the mole and ant hills, and other inequalities have been thus taken off, the best way is to carry them to a corner of a field, there to break them well to pieces, and mix them with a considerable portion of lime, which will effectually destroy every remains of the ants, and convert the whole to good manure, which may then be profitably spread all over the surface of the ground. The spots on which the mole or ant hills stood, should be loosened with a spade, then mixed with lime or other manure, and afterwards be laid down with clean grass seeds.

This method is the most advisable of any, because a fine grass will be raised in those places, instead of the coarse benty growth which occupied them before.

Draining of land is likewise a great improvement: for though meadows and pastures which are capable of being overflowed, produce a greater quantity

quantity of herbage, than dry soils do; yet, where the wet lies too long upon the ground, the grass will be four and extremely coarse; and if great care is not taken to drain such land, it will yield less and less grass, will soon be over-run with rushes and flags, and will then be reduced to little value. The soil most liable to this, is cold stiff clay, where the water cannot penetrate, but is contained, as in a dish: so that the wet which it receives in the winter, continues till the heat of the sun exhales it.

The best method of draining these lands, is to cut several trenches a-cross the ground, in those places where the water is apt to lodge, and other larger drains to carry it off from them, to either ponds or rivers in the lower parts of the land. These drains need not be very large, unless the ground lie quite low, and is so situated as not to be near any rivulet, or running stream, to which the water can be conveyed. In this case, indeed, large ditches should be dug, at proper distances, in the lowest part of the ground, to contain the water. The earth taken out of the ditches should likewise be carried to a corner of the field, and there be mixed with lime: after which it should be spread on the land, in such manner as to form a gentle declivity, on all sides, from the middle of the field.

Meadows which lie flat, and whose surface consists of a loose earth which affords an easy passage to water, whilst a stiff soil underneath retains it, are apt to grow four and cold, by means of the water so retained. For these, the under-ground drains before directed* are the most proper.

When these precautions have been taken, and the abovementioned obstacles removed, the ground

* Vol. I. p. 177.

must be cleared from every plant which is not intended to make a part of the pasture. But as some of these, though here properly termed weeds, by way of distinguishing them from the grass, may be useful in other places, and on other occasions; I shall treat separately of such of them as require any particular means, in order to their being destroyed, or by the propagating of which elsewhere, the farmer may be benefited. — The first that I shall speak of, is one of the most difficult to extirpate.

Furze, *wikins*, or *gorse*, to which C. Bauhin and Mr. Ray, give the name of *Genista spinosa*, and which Dr. Linnæus and Mr. Miller call *Ulex*, propagate themselves so rapidly, by sowing their seeds, that, where they are once established in a spot of ground, they soon over-spread the whole place: for, as the seeds ripen, their pods are opened by the warmth of the sun, and they are thrown out with an elastic jerk, to a considerable distance all around. There they vegetate, and the ground is soon filled with young plants, which are not easily destroyed after they have taken good root. The only way of extirpating them, is by paring off and burning the surface of the ground: the method of doing which has already been sufficiently explained. This is by so much the more adviseable, as these seeds will otherwise remain a long while found in the earth, and grow whenever they are brought up by plowing: and also because the smallest fragments of this plant will strike out fresh roots, and shoot up anew. But when a good thickness of the surface is pared off, and burnt, the seeds are so effectually destroyed, and the roots are killed to so considerable a depth, that neither can again give rise to new plants: and if a few of these do appear, a summer fallow will put an entire end to their growth. Their increase may likewise

wife be prevented by good manuring, with marle, chalk, or lime, especially in sandy soils, which are the most apt to produce this plant, and which are at the same time the most benefited by those helps.

However, thanks to necessity, that fertile mother of invention, this very plant, formerly deemed a great nuisance, is now cultivated to advantage on light, sandy, dry soils; which would otherwise turn to little account. The tops of the common English furze, bruised a little to take off or to blunt their prickly tops, have been found to be excellent fodder, even for lean sickly beasts, and particularly horses, which they have frequently recovered, and plumped up, in a short time. This custom is much practised in several foreign countries^f, where furze are cultivated purposely for fodder, and the peasant thinks it a happiness, that his breaking their spikes with a mallet enables him to give this wholesome green food to his cattle in the winter, when, often, no other succulent plant can be had, fit for that use. The mills which Sir Capel Hanbury has lately erected for this end in Wales, with a patriotic spirit well suited to his distinguished zeal for the public welfare, will save the countryman that laborious task, and prove highly beneficial to those who follow his judicious example.

When furze are raised on purpose for the food of cattle, and especially on soils like the above-mentioned, their seeds should be sown in February, March, or April, and the ground should be prepared as for barley. Six pounds of them will be sufficient for an acre of land; and they should be but barely covered over. The young plants must be preserved from cattle during the first year, and they will be fit to mow or cut in the

^f *Maison Rustique*, Tom. I. p. 640.

next. October is the proper time to begin cutting them. They will continue to shoot till Christmas, and be fit for use till March. Horses eat them as readily as they do hay, after they have been bruised or pounded so as to take off their sharp points; and it is said, that an acre of ground will produce fifteen tons of this fodder, and that it will go as far as an equal quantity of hay. Some mix the bruised furze with chopped straw; an hundred of straw to a ton of furze: but only the growth of the year should be cut for cattle.

Poor hungry gravelly soils, which would not have let for five shillings an acre, have been rendered worth twenty shillings a year, by sowing them with furze seed, in places where fuel has been scarce; this being frequently used, for heating ovens, burning lime and bricks, and also for drying malt: but it is not worth practising in countries where fuel of any kind is cheap, or upon such land as will produce good grass, or corn. Mr. Miller mentions it[§] in this light, only to shew, that the poorest lands may be so managed, as to bring an annual profit to their proprietors.

Some years ago, the common furze used to be much sown for hedges about fields, and, where the soil was light, the plants soon became strong enough for a fence against cattle: but as these hedges grew naked at the bottom in a short time, and the plants frequently failed, so as to leave considerable gaps, this practice has, of late, been greatly disused. The species commonly called French furze is the best for this purpose, because it thickens more near the ground, and grows to a greater height: but it's shoots are not tender enough for cattle to eat them. This is also deemed the most difficult to extirpate: though Mr.

§ *Gardener's Dict.* Art, ULEX,

Bradley, who tells us ^h that he had seen fields of fifty or an hundred acres planted with it in Devonshire, says ⁱ that it may be killed by cutting the woody stalks within a foot of the root in summer time; for that it will not then spring up again, like the small wild furze, or whins, by which name Mr. Markham distinguishes the small furze from the larger sort. This begins to blow in the middle of January, and continues in blossom all the summer; while the English furze does not bloom till towards the end of the spring, and finishes it's blossoming at the same time as the other.

The Marquis of Turbilly observes, that cows, oxen, and most other cattle, as well as horses, feed heartily, upon, and are well fed by, the bruised tops of furze; and that one may be sure corn will do well wherever this plant is met with ^k:—In effect, whatever the surface of the ground may be, the spontaneous growth of furze always indicates a depth of good mould underneath; and the continual dropping and rotting of the leaves will infallibly improve and enrich that surface.

The flowers of the furze are excellent for bees.

Broom (*Genista*), if considered as a weed, is one of the most pernicious plants that grows upon land, because it does not shed any leaves, but continually exhausts the goodness of the soil. The way to kill it is to pull it up before it seeds, to give the ground a summer's fallow, to burn-bake, and manure it very well with dung, ashes, &c. or with chalk, marle, or urine, which is yet more effectual. To destroy it on pasture land, the best way is to cut it up in May, when it is fullest of sap; because the roots will be killed by that

^h *Complete Body of Husbandry*, p. 166.

ⁱ *Ibid.* p. 171.

^k *Mémoires sur les Défrichemens*, p. 258.

means:

means: whereas in pulling it up, part of them are apt to be left behind, and the least bit will produce a new plant. Foddering of cattle upon the land is likewise a good way to destroy this growth, because, besides their urine, their treading upon it, and upon the soil, which is hardened thereby, helps to kill it: for we seldom find broom near old roads or path-ways.

Botanists distinguish several species of broom, some natives of this country, of which the *Genista trifolia* of Mr. Ray^m is our common sort. It rises about three feet high, with shrubby stalks, garnished with spear-shaped leaves, and terminated by loose spikes of yellow flowers, which are succeeded by short pods, which turn black when ripe, and contain four or five kidney-shaped seeds. It flowers in June or July, and the seeds ripen in autumn. The branches of this plant are used by the dyer's to give a yellow colour; from whence it is called dyer's-broom, green-wood, wood-waxen, or dyer's-weed.

The *Genista spartium minus Anglicum* of Tournefortⁿ, small English broom, called *petty whin*, rises likewise with a shrubby stalk, but only to the height of about two feet, sending out many slender branches, which are armed with long single spikes, and garnished with very small spear-shaped leaves, placed alternate on every side of the branches. The flower branches are without spikes, short, and have five or six yellow flowers growing in a cluster at the end. They come out in April and May, and are succeeded by short turgid pods, containing four or five small kidney-shaped seeds, which ripen in July. This sort grows naturally upon open heaths, in many parts of England.

¹ MORTIMER'S *Art of Husbandry*, Vol. I. p. 308.

^m *Hist. Plant.* p. 1723.

Hist. R. H. 645.

The *Spanish broom* (*Genista Hispanica*) branches more, and grows taller, than either of the foregoing sorts. It rises to the height of four feet, with erect stalks, wedge-shaped leaves somewhat broad and roundish at the top, but very narrow at their base. The flowers of this, which are larger than those of either of the preceeding species, and of a paler yellow, are produced in pretty long spikes at the end of the branches. They appear in June and July, and are succeeded by pods like the former sorts. This broom bears our winters very well in the open field, unless the frosts happen to be extremely severe.

The twigs of broom, and especially those of the Spanish, which are the longest, make good baskets, are used for binding, and for making of dry hedges, and are excellent for thatching; being very tough, and of long duration. Ropes also, and those not bad ones, for barges and other small crafts, are made of the stringy fibres of this plant, of which the ancients used likewise to make a kind of flax.

Mr. Bradley has calculated^p, and I believe he is much under the mark, that an acre of broom is worth upwards of six pounds, for the feeding of bees only, besides the wyths and stumps, which will pay for the rent of the land. Certain it is, that no flowers are more pleasing or more profitable to bees, than those of this plant, and especially of the species called the Spanish broom.

Other uses of broom, which ought not to be omitted here, are, that besides yielding some food to sheep, in the winter, it then affords them shelter against the inclemency of that season, and the land dunged by them, while they are folded thereon,

o *Maison Rustique*, Tom. I. p. 888.

p *Complete Body of Husbandry*, p. 181.

will afterwards bear two good crops of corn. Also in countries where there is a great demand for pearl-ashes, it will be well worth while to plant dry parched spots of ground, and steep declivities, which will scarcely admit of any other improvement, with broom, for the sake of its ashes.

The process by which their alkaline salt is obtained, is thus given by Dr. Holme, in his very useful and accurate experiments on bleaching^a.

“ Alkaline salt is extracted from the ashes of all plants, except those which have a pungent taste and smell, as onions, and scurvy-grass; and from all trees, except the most resinous; for these afford but a very small quantity of it. The plants or trees, when found, are pulled up, or felled, in the spring, and afterwards dried, and burnt to ashes. By pouring warm water over these ashes, the salt in them will be dissolved; and by straining this water, the salt is separated from the earth intermixed therewith. This saline liquor, which is called a *lixivium*, is then evaporated over a fire, and what remains is an alkaline salt, of the same kind as the pearl-ashes. As soon as it is taken from the fire, it must be put into vessels which will preserve it from the air; because it is so attractive of moisture, that it will run immediately into a liquid, if it has the least communication therewith.

Fern (*Filix*) is one of the worst of weeds, and one of the most difficult to destroy, where it has a deep soil to root in. Mr. Mortimer says^r he has seen its roots eight feet deep in some grounds: to which he adds, therein agreeing with Mr. Ray,^s and Mr. Lisle^t, that the best way of killing it is

^a Page 148.

^r *Art of Husbandry*, Vol. I. p. 309.

^s *Hist. Plant.* p. 143.

^t *Observations in Husbandry*, Vol. II. p. 292.

by cutting it often while it is in grass, and that the three most particularly proper seasons for so doing are, as directed before in other similar cases, the spring, midsummer, and michaelmas: that is to say, when the circulation of the sap is strongest. Most of the roots then cut asunder, and thereby deprived of the channels through which nature intended to convey that sap, will bleed to death, or, if it stagnates in them, will soon rot. The fern itself, if cut when full of sap, and left to rot upon the ground, will greatly improve the soil, and mellow it so as to prevent it's binding: or if it be burnt when so cut, it will yield a much greater quantity of salt, than any other vegetable. If it is plowed up, plentiful dunging of the land, and sprinkling it well with ashes, have been found to kill this weed: but the most certain cure for it is urine. In several parts of the north, where they keep their fern under, and destroy a great deal of it by mowing it frequently whilst green, they also find that rolling it is of great service to this end; and when they burn it, the poor make the ashes up into balls, with a little water, dry them in the sun, and use them in washing their linnen, for which they think them nearly as good as soap. Often treading down these plants, and feeding Scotch sheep on them, is said to be an almost infallible way to kill them.

Trees planted among fern will thrive very much, though it be on a hot gravel; the fern shading their roots, and keeping them moist and cool.

Fern likewise yields a considerable quantity of ashes, fit to make pot, or pearl, ash.

Wormwood (Absinthium), though a rank weed in pastures, yields likewise a considerable quantity of fixed alkaline salt; but not at all better than that of any other vegetable, notwithstanding the great
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stress that is seemingly laid upon it in medicinal prescriptions.

Reeds, rushes, flags, and such like aquatics, (*arundo*, *juncus*, *gladiolus*, &c.) are best destroyed by draining. If the drains are cut deeper than their roots, their nourishment will be taken from them. Ashes or soot will likewise kill them; and so will plowing of them up, and laying the land in high ridges, to drain it; or mowing of them very early, while the sap is in them: but if hay is made of this growth, it should not be dried too much; because that will increase it's coarseness. Plants of this kind always indicate a good soil; for a bad one will not nourish them, especially reeds^u, the chief use of which is for thatching, and making small fences in gardens.

Worn-out grounds are commonly over-run with moss (*musca*): but whatever restores the pasture to a good heart, will destroy the moss.

Not to run over here a needless enumeration of the names, &c. of the several weeds which are apt to infest pastures, I shall only observe once more, in general, that, as in the case of arable land, whatever plant grows in these, different from what the husbandman intends to cultivate, is a weed, and should be extirpated as such.

The most effectual way of doing this, is to let the grass remain uncut for a whole season, during which the farmer, or a person who knows rightly how to distinguish the plants that should be destroyed, should frequently go over the ground, and cut the roots of these, under the surface, when they are in full sap, and beginning to bloom. By this means they will be killed before they can sow themselves; and the good grasses, dropping their seeds in due time, will soon cover the vacant

^u MORTIMER'S *Art of Husbandry*, Vol. II. p. 310.

spaces. All annual weeds will thus be thoroughly extirpated: and as to the perennial, whose roots, which generally run deeper, must be killed, as well as their tops, it will be advisable, whenever they are so strongly fixed that they cannot be pulled up by the hand, without farther assistance, to cut their roots within the earth with a spade four or five inches wide, and made with a wing for setting a man's foot upon; after which they may be easily pulled up, without lifting the turf; or, if the plant should break at the neck, and thereby render it necessary to raise the turf, in order to get out the root, the turf may be laid down again in it's former place; so that the sward need not be spoiled in either case. This spade may be made so light and genteel, that a gentleman may use it as a staff when he walks through his fields, and amuse and exercise himself very agreeably and profitably by pulling up the weeds as they come in his way; thus freeing himself from so many robbers, who devour the food, and take up the place, of profitable plants.

This method, though more tedious, is, in the end, better than mowing the weeds; because, as long as any part of them is left above ground, they will be apt to shoot out anew; whereas, when they are cut asunder under ground, their tops will certainly perish, and their succulent roots will rot, and become a manure to the land which they impoverished before.

I must here observe, that quantities of weeds are frequently introduced into pasture grounds by the ill husbandry of farmers, who, in hard winters and very dry summers, feed their cattle there with foul straw, hay, haulm, vetches, &c. intermixed with the weeds themselves, or their seeds: and the same happens to arable land, when it is manured with new dung, or dung not thoroughly

thoroughly rotted. The seeds of weeds in old dung have lost their vegetative power, and therefore need not be feared.

After the field is cleared of weeds, and the grass withered, in the autumn, is the proper time to enrich the land with suitable manures.

The advantage which plants receive from manure spread upon the surface of the ground, arises from the rich particles of the manure being filtrated, as it were, through the surface of the earth, and carried down into it, by rain, or the melting of snow: but many of these particles are undoubtedly lost, and never reach the roots of the plants, in the common way of applying it.

M. de Chateauvieux, sensible of this inconvenience, particularly with respect to grass grounds, rightly concluded, that dung, for example, would have a much greater effect, if only just the surface of the meadow should be cut, and some of the internal parts of the earth laid open, so that the enriching particles of the dung may more immediately reach the roots of the grass.

He has succeeded admirably in this important improvement, by means of his three coultered plough, which is to be used thus. In November, or December, the whole surface must be cut with that plough, into slips three inches wide, which is the distance between each of the coulters. This will have two effects: first, the coulters will tear up great part of the moss with which all old pastures are infected, and gradually destroy it: and secondly, the coulters, piercing five or six inches deep into the earth, cut the extremities of many of the roots of the grass, and those cut or broken roots afterwards produce new ones, which will give fresh strength and vigour to the plants, and, as it were, renew them, and make them young again.

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This division of the surface of the ground, will be very beneficial to the meadows. If the following year proves wet, it will greatly favour the production of new roots.

To render this improvement still more perfect, as soon as the whole surface of the meadow is cut, dung must be carried on it, and spread as soon after as possible. The smaller the dung is broken, the more useful it will be: because it's minute particles will then be best carried by the rain into the traces which the plough has cut, and give surprising strength to the plants.

This method of repairing and improving poor or worn out meadows and pasture grounds, does not require any great quantity of dung: one load of it will go as far, in this practice, as three would in the common way; and be much more beneficial to the grass. M. de Chateauxvieux has tried it for some years, with all the success he could desire. His grass thus improved, has always been very thick and long, and has yielded him plentiful crops of hay, when fodder has been extremely scarce every where else. He thinks that one acre thus cultivated, will produce as much grass as ten in the common way*.

Another use which he makes of the three coultered plough is, to break up grass lands intended to be converted into arable. The coulters enter five or six inches deep into the ground, and cut the turf into parallel slips of about three inches breadth, as was said before. Two horses will be sufficient to draw this plough, even though it should have five coulters instead of three, as it may, for the sake of greater expedition.

When the whole surface is thus cut in slips, all in the same direction, M. de Chateauxvieux plows

* DUHAMEL, *Culture des Terres*, Tom. IV. c. 3.

the field cross-wise with a common plough, taking only about the breadth of six inches at each turn of the plough; by which means those slips of grafs are broken into pieces, the largest of which are not above six inches long and three inches wide.

These plowings should be performed before winter, and in the spring. The lumps of turf, exposed on all sides to the penetrating frosts of the winter, are either quite mouldered down, or rendered so friable thereby, that the field may be plowed afterwards with as much ease as if it had been tilled for several years.

M. de Chateauvieux's description of this plough, is as follows.

"The three coultered plough, *Plate IV. Fig. 2*, consists of a beam *A, B*, and two handles *C, D*, supported by the standard *E*. The two side pieces *F, F*, are fastened firmly to the beam by two strong iron pins *G, G*, on the other end of which a nut is screwed as tight as possible. These two side pieces, as well as the beam, are pierced with as many mortises *H, H, H*, as it is intended to use coulters. The coulters should fit the mortises as exactly as can be: and they should be placed at such distances from each other, that their points may form parallel lines three inches asunder, in order to cut the turf into slips of that breadth, as at *I, I, I*.

"1, 2, 3, are three coulters exactly alike, of which the blade *L, I*, should be made of tough well hammered steel. Only three coulters are represented in this figure, in order to render it less confused: but if it be thought proper to use five coulters, by which means the work will be greatly expedited, two additional ones may easily be added by making the side pieces *F, F*, wider in proportion.

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"The beam is pierced with the two mortises *K, K*, in order to fasten it to the fore-carriage of a common plough, by running the cross slave of that carriage through those mortises.

"The coulter is pierced with several holes, as from *L* to *M*, in order to raise them higher, or let them lower down: and they should be of equal length below the beam, that all of them may enter equally deep into the ground. Besides the pin which fastens them at top, a wooden pin should be stuck into the hole immediately below the beam, to prevent their being raised up by their pressure upon the earth."

M. de Chateauvieux will pardon me, if, as I never saw one of these ploughs work, I point out what seems to me an omission in this: According to the drawing, and to his account of it, too much depends on the skill and dexterity of the plowman; to keep the coulters at a proper depth; there being no support at the heel of the plough, to render it more steady; and take off the weight, and thereby lessen the labour of the plowman. I would therefore propose that an axle tree should pass through the beam, as near as may be to the back of the coulters, and that two wheels, proportioned to the length of the coulters, should turn upon this axle tree, at the distance of nine inches from each other. This distance will be sufficient to render the plough more steady, at the same time that those wheels will greatly lessen the plowman's labour; and as they will run an inch and an half beyond the tracks of the two outward coulters, if there are but three, and an inch and an half within the two outmost, in case there be five, they will not interfere with the intention of this operation. But if the space of nine inches between the wheels be not enough to keep the plough sufficiently steady whilst it works, the hus-

bandman may enlarge that distance till it answers his intention; provided the wheels be placed so as not to run in the channels cut by the coulter.

As the stress upon the side pieces *FF* cannot but be great, and will be very considerable if five coulters are used; I apprehend it will be right to strengthen them with a thick piece of wood (*N*) laid a-cross them, underneath, from side to side, (suppose at *O*) and screwed firmly to them and to the beam. Holes for the additional coulters may go through this cross piece, if that should be thought the most proper place for them: and if the axles on which the wheels turn when the plough works, are either screwed into the beam, or otherwise secured so that they may be removed at pleasure; a cheek (*P*), either of iron, or of wood (for there will not be any great stress upon this part when it is used for the purpose here intended) may be placed under each end of the cross bar, and the ends of the axles may be fixed into this, in the same manner as they were fixed into the beam. By this means the wheels may easily be shifted, and the beam will be raised so high, that the coulters will not touch the ground when this plough is transported from one field to another. The coulters may also be shortened underneath, by pinning them higher up: or the sledge frequently made use of for carrying a plough from one field to another, may be employed here very properly, by laying this plough down side-wise upon it. These, at present, seem to me to be the easiest ways of remedying the inconveniencies which a very ingenious, I am sorry that I must add, an anonymous, correspondent, whose letter is signed *E F*, has pointed out in this plough, of which he adds that he has seen one, though unskilfully made, and worked with some difficulty, used to great advantage in this country, both in a grass ground, and also to break the
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the clods and pulverize the earth, before the last plowing for corn.—But as I have here reasoned from speculation only, it would be an acceptable service to the public, if some one better skilled in mechanics would be so kind as to correct my errors. I heartily request it, as a thing which will be very useful to the world: and in the mean time I thank *E F* for his very judicious hints, the chief of which has long been an essential part of my plan, and will be attended to, so far as I may be able, with all the care due to an object of such importance.

When the farmer has cut the whole surface of his pastures with this plough, in the autumn, and manured it properly, he may safely promise himself great crops of grass.

Ground laid down to pasture may be considered, as to it's soil, in the same manner as arable land has been; excepting only that there is some difference in the application of the manure.

All strong soils should be improved by plowing before they are laid down to grass, unless they lie so flat, and are so liable to be overflowed, that there be danger of the whole mould's being carried off, after the sward is broken up. In this case, shelly sea-sand is peculiarly useful; and the more shelly it is, the better it will prove, as has been remarkably experienced in Cornwall and in Ireland, in the manner before related^y, as to corn: to which I am now to add, as a proof of it's efficacy in regard to pastures, that, in Cornwall, after the corn is taken off the ground, a fine white clover, or, if the soil be deep, some purple, springs up; and that this grass of well sanded ground, though it be but short, is, for the feeding of cattle, giving good cream, plenty of milk, and

^y Vol. I. p. 20.—23.

all other useful purposes, far superior to the longer grafs, where less sand has been used. Even garden herbs and fruits are greater in quantity, and better in quality, there, than they are elsewhere. It is also remarked, that little or no snow ever lies in those well sanded places; that a constant winter-spring prevails where they are; and that the harvest there is a month or six weeks earlier, than it is at the distance of only six or seven miles from thence^z. Nearly the same has also been observed of small gritty gravel^a, which has, moreover, been found, alone, to have destroyed rushes and other aquatic plants, and to have brought up a much finer grafs in their stead. Whether this success depends on those manures being of a calcareous nature, as hinted before, experiments have not yet determined, that I know of. Dry rubbish of houses, ashes, and all kinds of vegetable and animal manures, are likewise very serviceable here.

On wet clayey soils, lime is not found to produce effects equal to the expence attending it as a manure: but it is probable, that if the lime stones were broken small, and spread upon the surface of the ground, they would yield a greater and more lasting benefit, than when they are burnt^b. Unburnt chalk is likewise, perhaps, better than burnt.

A compost of such substances as are fittest for the above soils, and which have been particularly pointed out in the first volume of this work^c, may be prepared, or they may be used singly.

If the ground is apt to be overflowed with a running stream, the manure, of what ever kind it be, should be applied at the time when it is least

^z *Philosoph. Transf. No. 113.*

^a See *Vol. I. p. 27.*

^b See *Vol. I. p. 29. 30.*

^c Part I. c. I. §. I. p. 19. and §. III. Art. 4. p. 110.

liable to this flooding, which would seem, generally, to be after the first cutting of the hay: otherwise, it may be laid on at the usual time.

Sandy soils are improved chiefly by marle^a, which possesses every quality wanting in the sand, and, being easily dissolved in water, readily enters into, and enriches the ground. It is therefore, in itself, a treasure, wherever it is found; for it will supply the place of almost every other manure. Even barren lingy heath ground, in Norfolk, has been made to yield, by the use of marle, such crops of clover as were worth double the crops of wheat obtained from an equal space of land in the same country^c.

Clay is of too cold a nature for these soils, unless the sand lie very warm, and be naturally calcarious. In this case, indeed, it may be applied as it is taken out of the pit: but otherwise, a better way is first to burn it.

To this end, dig a quantity of clay, suppose six or eight loads, to begin with, in spits about as big as common bricks. The best time for doing this is in the summer, and in very dry weather; though it may not be improper to have the place where the fire is made, a little out of the sun, that the superior force of the one may not extinguish the other. — After the clay thus dug has been pretty well dried by the sun and air, make a little pyramid, as if for a bon-fire, of fern, straw, furze, brushwood, faggots, billets, coals, or other combustibles, and lay around this your pieces of clay, two or three spits thick, till the whole pile is inclosed, excepting only a hole in the side, to light it at, and another at the top, to make a

^a See *Vol. I. p. 37.*

^c *Philos. Transf. No. 37.*

draught. When the fire is well kindled, and the surrounding clay begins to be thoroughly heated, stop up these holes with clay, and continue to add all around, as before, more spits of this earth, placed in such order that the fire may be pent up within the heap, and never suffered to go out: for if that should happen, the work must begin again. After that the six or eight loads of this somewhat dryish clay are burnt, the heat within the heap will be so intense, that even damp clay, brought immediately from the pit, may be laid on without danger of extinguishing the fire, if it be not piled up too quick, or in very great quantities. Six or seven hundred loads are said to have been sometimes burnt in one heap, in this manner: but then it has risen too high to throw the clay up to the top of it, from the level of the ground. A kind of stage is therefore built in this case, and the spits of clay are cast down from thence. The pile must be watched and tended night and day, till it is entirely burnt. The reddest and strongest clays are reckoned the most fertilizing when burnt*, and the common price for

* I will not take upon me to contradict what is here advanced by Mr. Switzer †, in regard to the colour of the clay, because his experience may have proved it to be fact: but an observation of Dr. Home's induces me to think, that whatever earth contains iron, which all clays that burn red certainly do, is unfavourable to vegetation.

This accurate observer of nature took one pound of good rich mould, and mixed with it one drachm of salt of steel; then put it into a pot, and sowed some barley in it in the beginning of May. Some of the plants here shot up about an inch, looked very ill coloured and sickly, and then died; while other grains in another pot, filled with the same earth, but not mixed like this thrived very well ‡.

† *Method of raising Brocoli*, &c. p. 36.

‡ *Principles of Agriculture and Vegetation*, Exp. 16.

for burning them is a halfpenny a bushel, heaped measure. We owe to that excellent patriot, the Earl of Halifax, this very great improvement in husbandry, which is now much practised in Sussex, where they allow about seven loads to an acre of pasture land.

The Marquis of Turbilly practises and recommends^a similar methods of burning mole hills and other waste pieces of pared-off ground, and assures us, from his own experience, that the ashes produced thereby have been of signal service to his pastures, as well as to his arable lands. But he burns that earth somewhat more slowly, and keeps these perpetual furnaces, as he calls them, burning, till the great damps which fall towards the latter end of the autumn put out the fire; for even the heaviest rains will not extinguish it, if the piles are properly formed, and so far only attended to, as neither to let them want for fods or earth to keep up the fire, nor to load them with so much at a time, as to extinguish it. They are constructed in the same manner as is here directed for clay, and the ashes are taken away by degrees, as they are sufficiently burnt: for too much burning impairs their quality.

Experience has taught what reason would scarcely have suggested, namely, that pastures

I would therefore recommend the clay which burns to the lightest colour.—But however the fact may be in this respect, the operation of burning clay is certainly expensive and troublesome; perhaps so far as to deter some farmers from practising it. To these I must observe, that clay, be it never so stiff, may be fitted for their use, without burning, by mixing with it layers of fresh dung, lime, or any other calcarious substance, which will so far open the body of the clay, as to render it more soluble in water, and thereby more easily washed into the earth by rain.—Perhaps this method of using clay may be found more advantageous than burning it.

^a *Mémoire sur les Défrichemens*, p. 86.

which lie on a sandy bottom are greatly benefited by lime; for there are several instances of land which, thus situated, and thus treated, has retained a constant verdure, and been covered with fine grass, during such extremely dry weather as would otherwise have burnt it up. And another advantage attending this manure, is, that it kills the vermin which feed on, and destroy, the roots of the grass.

Nothing is so profitable to marshy pastures, as covering them with gravel. If the soil is naturally loose, clay may be mixed with the gravel: but if it be pretty strong, clean gravel is best. The earth, by degrees, loses it's marshy appearance, and the gravel seems to give warmth to the soil, so that the moisture evaporates. This is confirmed by the following experiment. A farmer in Swisserland; made a wooden bridge over a canal, and to render the path to it firmer, he laid a thick coat of gravel a-cross the meadow, which inclined to a marshy nature. He afterwards saw with surprise, that the grass came up in greater plenty, and of a much better kind, than before, so far as the gravel extended.

The same was also remarked, years ago, in Ireland, by Mr. King, who observed along the sides of roads made through bogs, that wherever a little gravel had been accidentally scattered upon the bog, it turned those spots into a green sod, covered with a very fine scutch grass: from whence he seems rightly to infer, that the same charge which sands or gravels land, will reduce a dried bog, even to be arable^k.

In loamy dry soils, lime is a most essential manure for grass: but it's effects will probably be

i *Mémoires de la Société Oeconomique de Berne, Tom. II. part. I. p. 69.*

k *Phil. Transf. No. 170.*

most lasting if the lime stone unburnt, and broken very small, is strewed over it. We have a striking instance of this in what happened to M. Duhamel, from the chipping of a block of stone at his seat at Danainvilliers, as related in the first volume of this work¹; where ample directions may likewise be found for other manures and composts, of which dung is one of the principal, suited to this kind of land.

The general manures indicated in the first volume of this work, for arable land, will be equally serviceable for pastures: such are, all rotten animal and vegetable substances, chalks, and, in an especial manner, lime, marle, and ashes of all kinds.

There are, in this kingdom, vast tracts of ground, known by the name of downs, on which are chiefly fed large flocks of sheep. Experience has abundantly evinced, that though the grass there is naturally short, it is an excellent food for sheep; and as the welfare of these creatures is of the utmost consequence to one of the most essential branches of the commerce of England, very great caution should be used in making any alteration in their diet, till it be well proved, by fair experiments, that a richer pasture does not injure their fleeces. I would therefore recommend, in the strongest manner, to gentlemen who have estates bordering on such downs, particularly on that extensive tract called Salisbury plain, which reaches from the westward of Marlborough to the sea, to bring some of their sheep into rich pastures, of different grasses, as well natural as artificial, and to keep them there for some generations, in order to ascertain with certainty, what the effect will be. — The word generations, may, perhaps, here terrify at first, as implying a long space of

time for these experiments, those who do not immediately consider in how few years this succession may take place. — A lamb reared from its birth on, for instance, burnet, will, in two years, bring a lamb, which, in two years more, brings young, and the sixth year may see the third generation: so that by the end of seven or eight years the fact may be ascertained.

If sheep will be equally benefited by richer pasture, then the farther improvement of these downs must become a matter of great concern, both to individuals and to the public; because, granting that they may be improved with safety, the number of our sheep may be greatly increased: but if such improvement should be found in the least detrimental to their wool, instead of being encouraged, it should be forbidden, even by law.

Downs, in general, are of a loose, sandy, dry soil, covered with a very thin coat of mould, in which the grass grows. In many places, a bed of gravel is soon met with, and in others chalk.

Where sand, or gravel, is the soil, the owner of such land generally has in his power an easy means of improving it; such soils being hardly ever without marle, or a rich earth, underneath them, at a greater or less depth. A borer, to find out this earth, and a covering of it when found, are all that is wanted here; but this covering should be frequently repeated, rather than laid on too thick at once. If the earth underneath is of a clayey nature, lime, mixed with it, will add inconceivably to its value.

Where the bottom is chalk, with a thin covering of earth, the improvement is more difficult. The aid of the plough will then be requisite, and part of the chalk must be plowed up, to give a greater depth of soil. Experiments have shewn,
that

that chalk thus loosened will become mould in a few years, by the putrefaction of animal and vegetable substances growing on, and mixed with it.

The following judicious instructions just now received in a letter with which I am honoured from the gentleman in Lincolnshire who was so kind as to favour me with his experiments on lucerne, mentioned before, are so applicable to the present subject, by pointing out an excellent means of improving shallow soils, like those here spoken of, that I cannot do better than give them in his own words; after thanking him for this farther proof of his benevolence to mankind, and regretting that, as I feared was the case, a former letter of mine did not reach his hands. — They will also convey to the public some farther observations, not generally known, concerning the culture of a valuable grass.

“ Mr. Tull says, that a deep soil is best for
 “ sainfoin. I believe every thing will grow better,
 “ in a better soil: but by what I have seen of this
 “ plant, I shall always prefer for it a shallow soil,
 “ where there is a rock, or some hard substance,
 “ within six inches, or a foot, of the surface, to
 “ stop the roots of the plants, and make them
 “ spread horizontally. This has not only the
 “ good effects proposed in M. de Chateaufieux’s
 “ manner of transplanting lucerne^m, but, it is
 “ said, occasions it’s filling the ground with more
 “ shoots, by their striking up from the knots of
 “ the roots. This fact I cannot verify: but cer-
 “ tain it is, that, in such soils as I hear speak of, a
 “ crop of sainfoin which at first appears very thin,
 “ will afterwards fill the ground perfectly well,
 “ and the plants of it will appear in much greater
 “ quantities than at first.

^m See p. 258.

“ I have several times broke off a root of sainfoin four or five inches within ground, and it always sprung up again. This is a small argument for the fact I mentioned.

“ Sainfoin is much cultivated in Lincolnshire. The common allowance of seed is five bushels to an acre. A gentleman south of Lincoln advised me always to sow a small quantity of trefoil with it (about four pounds on an acre). The reason is, that, in this exposed country, the young plants suffer more by the sun in summer, than by the frosts in winter. Now the trefoil, coming to perfection the first year, and living only three, will be a shelter for the young plants during the first year or two, and die off when the sainfoin wants it's room. This system is well supported by practice: but rye grass should on no account be sowed with it; that being, when left for fodder, a great impoverisher of ground.

“ Sainfoin is observed to get to perfection in three years, lasts good four or five, and then dwindles during four or five more. It's first crops are from one to two loads; it's second stage, from three to four loads, and it dwindles down again to one. — Last summer, which was remarkably dry, did very well with this grass.

“ I have sown sainfoin with barley, with wheat, without corn in the spring, and now” (this gentleman's letter is dated September 4th, 1763) “ am sowing some more at this present writing; but can form no judgment as yet.

“ Three years ago I drilled some, according to Mr. Tull's directions, in beds, with treble rows, and some at equi-distant rows. The horse-hoed beds were good, as far as they went: the others, drilled at a foot distance, gave so much room for weeds to come up, that the success was very moderate; which, indeed, would have been the
“ case

“ case with the former, had not the horse-hoe
 “ cleared them. On the whole, as far as my small
 “ experience and observations reach, I would never
 “ advise any one to drill this seed, but to sow it
 “ in the broad cast way, on land *very fine*, with a
 “ good quantity of seed.”

This gentleman is certainly right in saying, that there should be no great distance between the plants of sainfoin, if they are not horse-hoed; because then weeds will rise up: but in regard to the duration of this plant, the Memoirs of the Berne Society relate, that a field of sainfoin, which was quite worn out, was restored by spreading it with marle, half an inch thick, and that it doubled its produce the very next year; which, I am persuaded, would also happen in the above-mentioned case.

It is so common to find burnet growing naturally upon very dry and shallow soils, that there seems to be great room to think it will answer well upon the downs I have been speaking of, if it be cultivated with due care.

The time for laying manure upon pasture land differs, according to the nature and quality of the manure. Marle and clay should be spread upon the ground in the autumn, as soon as the after-mass is eaten off; because they will be mellowed by the winter's frosts, and washed in by the rains of that season: and the same may also be said of lime-stone and chalk. But if these last are made into lime, the best way is to spread that lime unslaked, because it gives an additional warmth to the land while it flakes. Where sand, gravel, rubbish of old buildings, or such other substances as are not dissolved by the rain, are used; they may be carried on at any time during the winter, especially when the surface of the earth

ⁿ *Année 1762, Part II. p. 29.*

is hardened by frost, which facilitates their carriage. If animal or vegetable substances are employed for manure, they should be spread immediately, as soon as they are carried on; and this should be early enough for them to sink into, and enrich the ground before the winter sets in: otherwise, it is best to defer using them till February, when the severe frosts are past: for the richness of such manures is soon, and easily, carried off by the heavy rains in the winter.

At all events, whatever manures are used, it is necessary to roll the ground well in the spring, and afterwards to rake away carefully all such fragments and remains of those manures, as the roller has not buried in the earth, such as straws, bits of dung, pieces of lime-stone, &c. because these would otherwise obstruct the growth of the grass, and render the future fodder disagreeable to cattle. This rubbish has been known sometimes to amount to almost as many loads as were first laid on; especially when the dung has not been thoroughly rotted. Careful farmers will therefore let their dung be reduced to a perfect mould before they lay it on their meadows, or, for want of such dung they will use ashes, pigeon's dung, soot, lime, chalk, marle, &c.

Those who are best skilled in the management of pastures dress their meadows every other, or at least every third year, for otherwise no good crops of hay can be expected: but the generality of farmers, following the old method, are so much distressed for dressing to supply their corn land, that they have not any to spare for their grass. What dung they do use for their pastures, is generally laid on them in the beginning of winter, and spread as soon after as can conveniently be done, and in this situation it remains all the winter. But this is a very slovenly way; greatly inferior, in
every

every respect, to the using of dung so thoroughly rotted, and reduced to mould, as to be entirely washed into the earth by the winter's rains; and vastly short of M. de Chateauvieux's method of cutting the sward in order to let in.

Besides two regular weedings every year, *viz.* in April and October, by cutting up the roots of docks, thistles, &c. in the manner before directed; particular care should be taken, at all other times, to pluck up every weed as soon as it is discerned: for some of these will now and then escape the farmer's notice, run to seed, and sow themselves; and others will sometimes, in spite of his attention, be brought into his lands from the neighbouring grounds. The keeping of his pastures clear from all such growths will contribute very much to their improvement; as will also rolling them with a heavy roller, in spring and autumn. This last operation will level the surface of the ground, so that it may be mowed close; and it will help greatly to sweeten the grass.

The farmer should likewise be careful not to let heavy cattle graze upon his meadows in the winter, if they are apt to be much softened by wet in that season. Such lands as these should be fed down in the autumn, before great rains come on; and drier pastures should be used, in lieu of these, at least till the return of spring. If there should not be cattle enough to eat down the grass in time, it will be better to cut off what is left, than to suffer it to rot upon the ground: for this would hinder the young blades from shooting up early in the spring.

The necessity of water, in all pastures, is self evident; as cattle cannot live without it, and the driving of them far for it is known to be prejudicial to their health, in hot weather, besides being attended with great trouble, and a considerable
loss

loss of time. This is so sensibly felt in many parts of England, that people are obliged to dig wells, even to such a depth as, frequently, to require the assistance of a horse to draw up the water. The means of rendering it easily come at, must therefore enhance the value of the land where it can be so procured, and are of very essential consequence to the husbandman.

Where the surface of the ground is sand or gravel, there seldom is occasion to dig deep for water; because such soils generally lie upon marl; or some other rich earth, through which the water cannot descend. Beds of clay are most commonly thicker than those of sand or gravel; and chalk is, too often, the thickest of all. But wherever water is wanting, the farmer should bore through the incumbent earth, if he intends to fit his land for pasture: and if he finds the expence of obtaining it too great, his best way will be to convert the ground so circumstanced into arable, or to plant it with timber trees suited to the nature of the soil.

Wherever water stagnates in a sandy or gravelly soil, the husbandman sees at once at what depth is the surface of the earth which retains it. But in other soils, and when this does not happen, Palladius^f, and the authors of the *Maison rustique*^g, give the following directions how to seek for water, with the greatest probability of success.

Where rushes, reeds, flags, willows, or other aquatic plants grow spontaneously, or where frogs are observed to lie squatted down close to the ground, in order to receive it's moisture, there generally is water underneath. — Persons who make it their business to find out springs for foun-

^f *De Re rustica*, Lib. IX.

^g *Tom. II. Liv. 3. Part. 2. c. 5.*

rains, cascades, &c. look upon it as an infallible sign of subterranean water, when they see a vapour arise frequently from the same spot of ground. — Others assure, that wherever swarms of little flies are seen constantly flying in the same place, and near to the ground, in the morning, after sun rise, there certainly is water under that spot. — Again, where water is wanted on land apparently dry, let a man, before sun-rise, lie down flat upon his belly, resting his chin upon his fist placed close to the ground, that his view may be directed quite horizontally, and not rise too high, and in that situation let him look steadfastly toward the east. If he then sees a tremulous vapour arise from any particular spot, let him mark the place, by noticing some neighbouring tree, shrub, or other indication, and he will find water underneath it. But this experiment is to be made only on ground whose surface is dry; because other exhalations, from a damp surface, would be apt, in this case, to mislead the enquirer. — Another way is thus. Dig a hole three feet wide, and at least five feet deep, and place at the bottom of it, when the sun is about to set, a pan, or basin, rubbed with oil on the inside: let the bottom of this vessel be uppermost; cover it with dry hay, ferns, or rushes, and over that with earth; and if any drops of water are found standing on it's inside the next day, a spring is probably not far off. — Or, put a new, unbaked, but well dried, earthen vessel into such a hole, and cover it as before; and if there be water in that place, this vessel will be found soft and wet the next day. — Likewise if wool be left all night in a trench of this kind, and water can be squeezed out of it the next day, little doubt remains but that plenty of water may be met with there.

The month of August is generally looked upon as the most proper time to search for water: because, I apprehend, as the heat of the preceding summer will have warmed the earth to a considerable depth, any steam arising from water withheld by an impervious soil underneath; and particularly in hollows in the surface of that impervious soil, will then be most exhaled by this warmth. Now it is this steam, or vapour, which produces the beforementioned signs.

By whatever method water is found, the means of coming easily at it are the next consideration. If it be on a plain, there is no other way than digging a well. In doing this, the substance under the sand or light soil must be dug into, to form a reservoir of water for occasional wants; and this reservoir should be made deep and large, in proportion to the quantity wanted. If there were no such reservoir, the water, after having risen a little above the impervious body underneath, would glide along it's surface, as usual, and very little of it could then be obtained, either by pumps, buckets, or any other way employed to raise it. If the well is made in a sloping ground, and the declivity is sufficient to give it an horizontal vent, it will be worth the husbandman's while to dig such a passage, and, by means of pipes, or any other conveyance, to carry the water across the light soil, through which it would otherwise sink. The greatest quantity of water will be obtained in this manner, because there will then be a continual stream.

If the soil is very deep, and it's surface has inequalities in which rain water runs in any quantity; this may be collected in ponds made in the lowest parts of such grounds.

If a body of clay is found near the surface, it is worth the farmer's while to bore, that he may know

know at what depth a bed of sand or gravel may be met with: for he will be sure to find plenty of water in this last. If this be in a declivity, he need only cut an horizontal passage, and the water will flow so freely as even to double the value of his land.

Here again the farmer needs not ever to be at a loss, because it cannot be very difficult to make a pond in a clayey soil, which is, of itself, retentive of water. But it may, perhaps, be advisable, even in this, to cover the bottom of the pond with a coat of gravel, in order to prevent it's being poached by cattle, whose feet would otherwise be apt to sink deep into clay. Some farmers, judiciously, pave the declivity by which the cattle enter into the pond, and this renders it much more lasting than it would otherwise be.

When ponds are made in a loose soil, much more care is necessary. The bottom and sides there must be covered with a thick coat of the toughest clay, from a foot to two feet thick, well rammed down. Some have added hair and loam to the outer part of this covering, with a view of rendering it less liable to chap; but a thick coat of gravel is more necessary here, that the feet of the cattle may not pierce through the clay. — Perhaps the expence of paving the whole inside of a pond, might, in the end, be money well laid out.

The greatest difficulty of finding water is in chalky soils, because these are not, of themselves, very retentive of it, and generally lie in such thick beds, that it is expensive to dig through them. However, it should be tried; and if sand or gravel be found underneath, water may be depended on. Even here, ponds are easily made, by digging into the chalk, and lining them with a coat of clay, as before directed. If there is a

supply of proper manure, such as clay, or marle. this situation is well adapted to grain, which loves to stand dry; and as this kind of ground produces more forward crops than clayey or strong soils, it may be sowed early with corn, which will not, in that case, be so apt to be parched up as grass is, by the summer's drought. If a good soil can be made here, a foot deep, it will yield plenty of various sorts of pasture, either roots or grasses, as the farmer shall judge most proper: or it may be planted with different kinds of timber trees, as will be pointed out when I come to treat of forest trees.

Water, together with the different particles, which it carries along with it, constitutes great part of the nourishment of plants. A certain degree of moisture is necessary in order to their living and growing, as appears in our dry pastures, which constantly yield more grass in wet, than in dry years; and in meadows that are properly watered. Mountainous countries preserve their verdure better than extensive vallies, because the loftier part of the air is moister, or deposits more humidity, and fills the hills with more springs, which are only the surplus of that moisture, originally diffused equally in high situations. We are hereby taught, and the precept is verified by the annual overflowings of the Nile, Euphrates, and other rivers, the advantage of watering, and how attentive the farmer should be to the due and rightly timed application thereof. Yet it's use is limited; for too much flooding renders the earth marshy, and fills the grass with a watery juice, much less nourishing than when only the proper quantity of water has been let in upon it.

Many owners of pastures situated above the natural level of any adjacent water, have found their account greatly in raising it, by the help of engines, to such a height as to be able to overflow them

them easily, though at a very considerable expence, especially at first.

According to the quantity of the water intended to be raised, and the height to which it is to be raised, different instruments are used. If it be raised but to a small height, a windmill with a scoop wheel, as described in the first Volume of this work (*p. 140. Pl. II. Fig. 2 **), may suffice; or that with the pump (*Vol. I. Pl. II. Fig. 4. p. 140*) may be used if the water is to be raised higher.

The oldest instrument used for this purpose is known by the name of Archimedes's water screw, and is thus described by Mr. Emerson ^h.

C p D (*Plate IV. Fig. 3*) is a cylinder which turns upon the axis *C D*. About this cylinder there is twisted a pipe, or rather several pipes, *no, pq*, running spiral wise from end to end. This cylinder is placed higher at one end, *D*, than at the other; and it's use is to screw up the water from the lower end to the higher. *A B* is a river running in the direction *A B*. *a, b, c, d*, are several floats fixed to the cylinder. *E F* is the surface of the water. As the cylinder stands in an inclined position, the upper floats *a, b*, are set out of the water, and the under ones *c, d* within it: so that the water acts only upon the under ones *c, d*, and turn about the cylinder in the order *a, b, c, d*. By this motion, the water taken into the spiral

* I gladly embrace this opportunity of begging the reader's pardon for the following errors in the lettering of the Figure here referred to, *viz. Fig. 2. Pl. II. Vol. I.* and beg he will be so kind as to correct them with his pen. Instead of *E*, the engraver should have put *C*; instead of *L*, he should have put *E*, instead of *S*, he should have put *G*; and instead of *R*, he should have put *F*, to make it agree with the printed description (*p. 140*) which was worked off at the press some time before the engraving of the plate was finished. I confess my inadvertence, in not examining it then so carefully as I ought to have done.

^h *Principles of Mechanics, p. 223.*

tubes at the low end is, by the revolution of the cylinder, conveyed through these pipes, and discharged at the top into the vessel *G*. If *AB* is a standing water, there is no occasion for the floats *a b c d*; and then the cylinder is to be turned by the handle at *D*. Instead of the pipe, a spiral channel may be cut round the cylinder, and covered close with plates of lead. The closer these spiral tubes are, the more water is raised: but it requires more force. Also the more the cylinder leans, the more water it carries; but to a less height.

Where a considerable quantity of water is to be raised, a greater force is requisite, than can be applied to such a handle. Her Royal Highness the Princess Dowager of Wales has caused an instrument of this kind to be erected at Kew, and by means thereof a sufficient quantity of water is supplied, for all the ponds, and other uses, in that elegant and extensive garden: but it is there worked by horses.

The most common engine for raising water is the Persian wheel, of which Mr. Worlidge gives the following description i.

“ This wheel is made much after the manner of
 “ that of an under-shot mill, *viz.* with a double
 “ ring, into which are let two pins, on which the
 “ floats are fastened. These floats are made hollow;
 “ the half that is the most remote from the wheel,
 “ holds the water which is taken in at the open
 “ place, above the middle of the back of the
 “ float, and as the wheel goes round, and the
 “ float laden with water rises, so the water, by
 “ degrees, tends towards that part of the float
 “ which is next the wheel, and as the float sur-

i *Systema Agriculturae*, p. 20.

“ mounts

“ mounts the cistern or receiver, the water
 “ empties itself into it, every float succeeding
 “ the one the other, emptying itself into the re-
 “ ceiver: so that if one float contain a gallon of
 “ water, and there be 30 floats on the wheel, at
 “ one motion round it delivers 30 gallons of water
 “ into the cistern. Such a wheel will be about
 “ 15 foot diameter, the floats at 18 inches di-
 “ stance, and will deliver the water at 11 or 12
 “ foot above the level of your stream, and will
 “ go four times round in one minute, and carry
 “ up above 120 hogheads of water, in an hour,
 “ with 12 or 18 inches penning or stopping of
 “ but an ordinary current of water, which will
 “ water very well 30 or 40 acres of land: for
 “ if your land be cold and clayey, too much
 “ water does it hurt; and if it be light, warm, or
 “ sandy, a little water does it much good. It
 “ is also to be observed, that this motion is con-
 “ stant, and will last many years without repair,
 “ so that it stand not still, for one side to dry
 “ and wax lighter than the other: also observe,
 “ that the slower it moves, the better it delivers
 “ the water.

“ The view of this wheel we have in *Plate IV.*
 “ *Fig. 4.* *a a a a* signify the wheel; *b*, the cistern
 “ that receives the water; *c c*, the trough stand-
 “ ing on tressels, that conveys the water from
 “ the cistern to the place you desire; *d*, the hatch,
 “ or pen-stock that bays up the water to a rea-
 “ sonable height, under which the water drives the
 “ wheel; *e* (*Fig. 5.*) one of the floats presented
 “ open to your eye, apart from the wheel; *f*, the
 “ place that is to receive the water; *g*, the open
 “ place out of which the water issues; *h h*, the two
 “ pins or ledges riveted on to the foreside of the
 “ float, and wherewith you are to fix the float to
 “ the two rings of the wheel. These, or such like
 C c 4 “ wheels,

“ wheels, are much used in Spain, Italy, and
 “ France, and are esteemed the most easy and ad-
 “ vantageous way of raising water in great quanti-
 “ ty, to any height within the diameter of the
 “ wheel, where there is any current of water, to
 “ continue it in motion, which a small stream will
 “ do.

“ How many acres of land lie on the declining
 “ sides of hills by the sides of rivers, in many
 “ places where the water cannot be brought unto
 “ it by any ordinary way? yet by this wheel
 “ placed in the river, may the land be continually
 “ watered, so far as is under the level of the water
 “ when raised.”

Instead of raising the water by means of the hollow floats placed around the outer circumference of the rim of the wheel, as here described; M. Belidor proposes^k, for wheels of this kind, to raise it in buckets placed at equal distances upon the side of the rim of the wheel, and suspended by a pin, upon which they play, as at *A Fig. 6, Plate IV.* When, by the rotation of the wheel, one of these buckets comes to *B*, which is the summit of the wheel, the upright piece *D*, which is fastened to the side of the trough *C*, turns that bucket upon its side, and thereby makes it empty itself into the trough *C*, from whence the water is discharged into a receiver at *E*. — As these buckets keep full of water till they are carried up to the top of the wheel, where they are turned over; a much greater quantity of water may undoubtedly be raised by them, than can be by the floats of the Persian wheel, from which much must be spilled as it is carrying up. The size of these buckets should be adapted to the force of the current of the water which they are to take up.

^k *Architecture Hydraulique, Tom. I. p. 386, Pl. IX. Fig. 3.*
 Another

Another excellent wheel for raising water though not to so great a height, is represented by *Fig. 7, Plate IV*. This engine was first invented by M. de la Faye, of the Royal Academy of Sciences at Paris, and is now used with great success by the honourable Mr. Hamilton, at his seat at Pain's hill in Surrey, where that gentleman has shewn to the world how far a most barren spot may be rendered useful, and an ornament to the country.

This machine consists of a wheel whose size is suited to the height to which it is intended to raise the water. This wheel turns upon it's axis *A*, and has four curved pipes *B, C, D, E*, fixed to it, as in the figure. The mouth of the pipe ascends as the wheel is turned round by the stream, in the direction here indicated by an arrow, and the water descends from *B* towards *F*, till the wheel has made half a turn, when it is discharged into the hollow axle tree *A*, from the opening at the end of which it is conducted by troughs, or other channels, to wherever it is wanted.

Though experience hath long evinced the great advantages arising from the overflowing of pastures, it is but of late years that this very profitable improvement is become pretty general in England; nor is it, as Mr. Worlidge observes¹,
 “ yet carried to near the perfection it might be
 “ advanced unto, if the following obstructions
 “ were removed.

“ 1. The several interests that are in lands bordering on rivers, hinder very much this improvement, because the water cannot be brought over several quantities of land so circumstanced, but through the ground of ignorant and cross neighbours, who will not consent thereunto

¹ *Systema Agriculturae*, p. 19.

“ (though

“ (though for their own advantage also) under
“ unreasonable terms; and some will not at all.
“ Others, again, are not, by law, capacitated for
“ such consent.

“ 2. A great and pernicious impediment to
“ this improvement is the mills that stand on
“ many fruitful streams; prohibiting the laborious
“ and ingenious husbandman to receive the bene-
“ fit and advantage of such streams and rivers,
“ which carry in their bowels much wealth
“ into the ocean, while the mills themselves yield
“ not a tenth of the profit to the owners, that
“ they hinder to their neighbours, and their work
“ may be as well performed by the wind, as by
“ the water.

“ 3. Another grand impediment is the igno-
“ rance of the countrymen, who are commonly
“ possessed with a foolish opinion, that the
“ water leaves all it's fatness on the ground it
“ first flows over, and therefore will not benefit
“ the next; which is most untrue; for I have
“ seen meadows successively drowned with the
“ same water, to almost an equal improvement for
“ many miles together. It is true, the water leaves
“ behind it a great part of the fatness which it
“ hath washed from the hills and high-ways in
“ the time of great rains: but we find by daily
“ experience, that meadows are fertilised by over-
“ flowing, as well in clear and dry weather, as in
“ rainy, and that to a very considerable degree.
“ The clearest and most transparent streams will
“ improve even ordinary lands, so much as to
“ render them fertile meadows.

“ 4. From a greedy and covetous principle,
“ the grass is suffered to stand so long on the
“ watered meadows, that it becomes much dis-
“ coloured, grows haulmy, and is neither so tooth-
“ some

“ some nor so wholesome, as that of unwatered
 “ meadows.

“ 5. The former of these impediments might
 “ easily be removed by a law, which would be of
 “ very great advantage to the kingdom in general. The latter can be remedied only by the
 “ example of such industrious and worthy persons as understand better things: the generality
 “ of the world being rather introduced to an ingenious and profitable enterprize by example,
 “ than by precept: although some are so sordid
 “ and self-willed, that neither apparent demonstration, nor any convincing argument whatsoever, can divert them from their bias of ill
 “ husbandry.”

The industrious Swiss, sensibly attentive to every means of benefiting their deservedly cherished country, have thought this branch of husbandry of sufficient importance to propose it for the first premium offered by their truly laudable Society at Berne, for the year 1760: and I gratefully confess myself indebted to the dissertations^m produced thereby, for several of the following remarks.

Water not only acts as a vehicle to the nourishment of plants, but also carries with it many particles which enrich the soil; especially after heavy rains. It then deposits a fertilising sediment, which turns the mould to a blackish colour. The common saying, that *watering makes the stones disappear*, is true; not so much from their sinking into the earth, as from their being covered by the new supply of mould brought by the slimy muddy water, particularly after great rains. Watering likewise promotes the putrefaction of every vegetable

^m *Mémoires de la Société Oeconomique établie à Berne, Tom. II. Part. I. p. 12. Part. III. p. 483.*

getable and animal substance found in the earth, and thereby contributes greatly to meliorate the soil underneath the sward.

Plants which grow on dry pastures contain richer and more nourishing juices, than those which grow in moist places. Care should therefore be taken, that the quantity of moisture brought upon the pasture, be only such as shall give vigour to the plants, without over-charging their vessels. In order to do this, every part of the pasture should be watered equally, and as little water as possible should be suffered to go where the land is naturally moist.

Extreme heat should also be avoided in watering; because heat draws the moisture too hastily up into the plant, which is thereby filled with a watery juice, and rendered of so tender a texture, as easily to be killed afterwards by drought or cold.

If the spring proves dry, pastures may be watered as soon as the frosty season is over; and this may be continued till the grass begins to shoot. But if the winter has been severe, and the earth remains moist, no current of water should be admitted, till the earth loosened by the frost is settled, and the surface become pretty dry: for even the gentlest stream would carry off the fine mould loosened by the frost. After that the grass has begun to shoot, and the weather is become mild, the water should be administered more sparingly; that is to say, in such proportion only, as just to push the grass gently on, till it has made such a covering as can shelter the earth from the too great power of drying winds, or of a scorching sun. Watering should afterwards be used with great caution, and only in case of extreme drought; nor even then, unless the water be perfectly clear and sweet, lest it should foul the grass, or give it
a bad

a bad taste. If it be admitted sparingly before the hay is cut, it will make the grass stand the better to the scythe.

For a little time after the hay is made, the water should be admitted only in the night; because the weather then generally is very warm: for it is observed, that rain which falls with a hot sun, or a hot sun that comes on a heavy dew, is prejudicial to plants. Watering, under the same circumstances, will have the same effect: to prevent which, the prudent husbandman will let in his water only in the evening, and will withdraw it again before the sun gets up. It is continued at this season only till the grass begins to shoot vigorously; and in case of very great drought it may be repeated, but very sparingly.

If a second crop of hay is made, the water may be used more freely; as the weather is then become cooler, and the earth is generally very dry. This flooding will bring up a plentiful after-mais. If the second crop of grass is fed off, the watering should be renewed in the same manner: only care should be taken not to suffer cattle to feed on the ground while the water is upon it, because their poaching would destroy the roots of much of the grass, and leave the surface uneven; which should be avoided in a pasture.

The latter end of autumn is the season in which watering is the longest continued; and considering the dryness and parched state of the earth at that time, this practice seems rational; for the water then, not only supplies the moisture wanted in the earth, but it dissolves every substance soluble in water, and thereby converts to an additional manure, what might otherwise have remained long in its original state. Care should, however, be taken, to drain off the water before the season of strong frosts is expected; because frost is ob-
served

served to destroy all kinds of vegetables much more when the plants are full of sap, than when they are in a dryer state. We may easily comprehend that it must have this effect, when we consider with what force it breaks every vessel containing water exposed so as to be frozen: for frost dilates all fluids to such a degree, that the vessels in which they are must be broken thereby. Hence it is that succulent plants soon become a putrid mass after a hard frost: and thus it is that the strongest trees are sometimes burst, with a loud report.

When the water is brought to the desired height, the main channel should be cut, with such a descent as only just to keep the water in a gentle motion. That channel should be made in the highest part of the pasture, and proportioned to the quantity of water necessary to be introduced. If a hollow intervenes between the place at which the water is brought into the field, and another rising ground in that field; it will be worth the farmer's while to convey it a-cross that hollow, by pipes made of wood, or any other substance, laid either horizontally over that hollow, or underneath it. The motion of the water in this horizontal channel should be different, according to the quality of the ground. If it is a strong earth, the channel may be cut nearly horizontally: but if it is a light loose soil, a quicker current should be given to the water, in proportion to the degree of lightness of the earth; or great part of the water will otherwise be lost, by sinking into it. In a light soil of this kind, it may be proper to line this main channel with brick or stone, well cemented with lime, to hinder the water from escaping through the crevices; or at least to cover it with clay well rammed. As to the degree of descent most proper for the main channel, in order
to

to give a current to the water. M. Bertrand, to whom we owe one of the ingenious dissertations on this subject in the Memoirs of the Berne Society, observesⁿ, that Vitruvius required six inches in an hundred feet, which is a great deal too much: but that the moderns, who have made the most exact experiments in this respect, are satisfied with two inches in six hundred feet, when they cannot have more, and recommend particularly the avoiding of all sharp angles in the winding of the channel, and the making of it's bottom quite smooth and even. He adds, that this is nearly the declivity of the aqueduct of Rocquancourt, by which the water is conveyed to Versailles; the distance there being three thousand four hundred yards, and the slope, in all, only three feet.

The main channel should be of breadth, rather than depth, sufficient to receive all the water that is intended to be conveyed through it, and that breadth should lessen gradually as the water is carried off in lesser channels, in order that the water may press into those smaller ducts, which are to issue all along from the chief. The lesser channels should be as shallow, and as numerous, as can be: for the more equally the water is distributed over the grass, the greater will be the improvement. They should be made particularly wherever the water collects itself into a stream: for though cutting so much turf may seem to waste a great deal of land, yet it proves not so in the end; because the quicker the water runs over the grass, the more it benefits the pasture.

To keep the channels in repair, they should be frequently cleaned, especially after every cutting of the hay. The slime then taken out of them

ⁿ *Tom. II. Part. III. p. 90.*

should

should be spread upon the pasture, and the next growth of the grass will be greatly improved thereby. Care should also be taken to have drains to carry off the water, so that none of it may stagnate upon the land.

The best way of watering a flat meadow, which is usually surrounded with a ditch, is to stop the out-let of the ditch, and, by bringing in a quantity of water, to overflow the whole meadow, for such time as shall be judged necessary to moisten the earth sufficiently: but the water should not be continued upon it so long as to wither the grass. If this can be done in a rainy season, it will be so much the better; because the water will then be loaded with the enriching mud and slime washed down from the higher grounds.

The first heavy rains which fall in the latter end of the autumn, and which carry with them the rich particles of putrified animals and plants, are thought to be more fertilizing than at any other season of the year, and are therefore brought into the pasture, as often as the absence of the cattle fed on them will permit.

The next best to rain, is clear and sweet spring water, flowing from a copious source. Here it is generally objected, that spring water is hard, and therefore not fit for the nourishment of plants. But Dr. Home, who judges otherwise, expresses himself thus on this very occasion. Is not hard "water more nourishing for vegetables than soft "water? I imagine, that the salt of vegetables "enters their vessels in such a form as hath the "salt which is found in hard waters. The salt of "hard waters seems likewise to be of the nitrous "kind, of which the nourishment of plants is also "supposed to be—This query thwarts the gene-

• *Experiments on Bleaching*, p. 300.

“ral opinion: for no gardener will make use of
 “hard water, if he can avoid it. — I watered some
 “plants with it, and thought that they grew
 “better than those which were watered with soft
 “water.”

This is confirmed by an ingenious correspondent of the Berne Society^p, who made several experiments on the qualities of different waters, and found that their greater or less hardness made very little difference in their effects, when used for watering of pastures. The water of an excellent spring, which, upon trial, was found to be hard, fertilized greatly the pasture upon which it was let in.

Spring water may be used later in the winter, than any other, because, being warm, a mild frost will not freeze it, even when expanded on the pasture. It should however be turned off soon enough to let the earth become a little dry before severe frosts set in. It may likewise be used earlier in the spring, than other water, and to better advantage, by reason of the warmth which it communicates to the ground where it flows: and it becomes extremely proper in the summer, because it cools during the night (the only time for watering at that season) the heated soil, and grass scorched by the power of the sun.

The equal warmth of spring water, is what renders it peculiarly useful for watering pastures. The last quoted correspondent of the Berne Society tried it's heat, in Swisserland^q, on the 26th of May, when the earth had been very little warmed by the sun, after a long winter's cold. He then found M. de Réaumur's thermometer, placed in the spring of water, stand at $8\frac{1}{2}$ degrees (equal

^p *Mémoires pour l'année 1761, Tom. II. Part. I. p. 97.*

^q *Ibid. p. 100.*

to $47\frac{1}{2}$ of Farenheit's) above the freezing point. On the 5th of July, in the evening, when the heat of the air was very great, Réaumur's thermometer, again placed in the spring, stood at $9\frac{1}{2}$ degrees (equal to 49 of Farenheit). He afterwards tried whether the warmth of the spring was considerably increased towards the end of the summer, when the earth was extremely heated: but even then, Réaumur's thermometer scarcely reached 10 degrees (equal to about 50 of Farenheit's). By this we see, that springs which yield a full and constant stream vary very little in their degrees of warmth.

For the same reason it also is, that a perpetual verdure reigns around such springs, even during the hardest frost; and if their water could be preserved from freezing when spread over a field during the winter, it would be right to let them in upon pastures in that season: but as they soon lose their heat when dispersed over the grass, this is by no means advisable.

Experience has taught the inhabitants of the Alps (and the same will hold equally true in all mountainous countries), that it is not advisable to water pastures with the floods which arise from melted snow, or with the water of rivers fed thereby. — One reason which seems to render the water that descends from mountains perpetually covered with snow less useful for watering pastures, is, that as all vegetation is at a stand in such places, no vegetable matter can be mixed with this water, and it therefore cannot communicate the fertility which arises from waters fraught with those rich substances.

We are frequently told of correcting the crudity of water, by making it turn a wheel, or putting it otherwise into violent motion: but I know not what good effect this can have.

What

What are commonly called barren springs, are sometimes corrected by mixing dung with their water in ponds made higher than the pasture intended to be watered. Yet this, though an old custom, is liable to some objections; one of which, in particular, is, that the water will deposit it's richness on the first part of the pasture over which it flows, and therefore improve the grass very unequally. But if dung has this effect, it will answer equally well, if it be spread upon the land. Care should, indeed, be taken, that the current of the water be very slow over a pasture newly dunged; because the fertilizing particles of the dung may otherwise be carried off by the stream, before they can have had time to penetrate into the earth.

When dung, marle, or lime, is laid on a pasture which has a considerable descent, the best way is to lay a larger proportion on the higher parts; because the common rain water will wash some of their richer particles down to the lower.

As clayey soils retain water, and by that means chill the plants growing on them, they are the least fit for watering of any. If the water abides on them, they become poachy; and when dried again, they gape, and become so hard that no plant can pierce them. Some sensible farmers have likewise observed^r, that their clayey lands have always yielded less grass in wet years, than when the season has been dry; which is a manifest proof that a soil of this kind does not admit of watering, unless it be a little, in case it's surface is become hard after the hay has been taken off, or when the grass is short. Such lands are fitter for arable, if their situation permits it.

^r *Mémoires de la Société Oeconomique de Berne, Tom. II. Part. I. p. 70.*

Hazel earth, which is a loam mixed with gravel, and of a clayey nature, is the strongest soil that can be watered with propriety: and that this has been surprizingly benefited thereby, is evident from several instances given in the Memoirs of the Berne Society, even of large tracts of such ground that have been vastly improved by this means: but I shall mention here only the following.

“ In the summer of 1758^{*}, part of the pasture ground belonging to a farmer in Swisserland was so entirely covered with stones and gravel, by the sudden overflowing of a stream, that it looked like a bank of sand. As the removing of this quantity of stones and gravel would have cost a great deal of labour and expence, the owner of the land carried off only the largest stones, and threw over the gravel a reddish earth taken from a neighbouring hill; but so thinly spread, as only to fill the interstices between the pebbles, without entirely covering them. He then sowed this spot with hay seeds, and let in upon it the waters of an adjacent spring and a neighbouring rivulet. These waters were let in sparingly at first, till the grass began to appear, and after that they were flowed more abundantly. The consequence of this prudent conduct was, that the grass thus raised bore cutting once the first year, and after having been mowed twice in the second, promised an excellent aftermath at the time when this account was written, which was in the beginning of the autumn of that second year. The very first year's crop grew so prodigiously, that the grass was lodged, even though the pebbles were then felt under foot, if one trod upon it.”

Black rich mould requires but a moderate quantity of water; just sufficient to give action to the fertilizing particles which it contains. The

^{*} *Ibid.* p. 76.

watering here should be frequently repeated, rather than long continued.

It is a general rule, that sandy or gravelly soils require watering the most of any; because, whatever moisture they receive, sinks through them too speedily. But it may be doubted, whether this very reason for watering them, be not one of the greatest of objections against their being watered, at least so much as is generally directed: for the water not only passes rapidly through these soils, but it may carry down with it through the sand or gravel, the finer and richer particles of the shallow mould usually found upon such soils, and thereby rather impoverish their surface. It would therefore seem advisable, to let water in upon such soils only occasionally, to refresh their verdure, when their surface is too dry: and to give it a pretty quick current, that it may reach to a greater extent of surface: for if it runs slow, it sinks too fast.

It is a question whether pastures newly laid down to grass, after having been arable land, ought to be watered at all during the first year. The judicious author of one of the ingenious dissertations before referred to in the Memoirs of the Berne Society, consulted on this subject an intelligent farmer, who had experienced the effects of watering, and of not watering, these *new* pastures, as some call them, and was answered: that they had yielded the greatest quantity of grass the first year, when they had been watered, but that the crops had always dwindled in the succeeding years: whereas those that were left dry till autumn, and then only begun to be watered, had made ample amends during the following years, for the scantiness of their produce in the first. This husbandman was therefore of opinion, that it is best not to water these meadows before

* *Ibid.* p. 85.

the autumn; and he added a farther very sensible reason, namely, that as these new meadows still retain some portion of the manure laid upon the land the year before, when it was sowed with corn; the letting in of water upon them, while the mould is yet extremely loose and light, will be apt to carry off those rich remains of manure, which will otherwise incorporate with the soil, as it acquires more consistence.

A very wrong custom which prevails among our farmers in general, with respect to low meadows, is, that of flowing them during the whole winter. The roots of all the sweetest kinds of grasses are thereby destroyed, and only such left as are natives of marshes, which are coarse and sour, and which no cattle will eat.

The method which Mr. Miller proposes^u for the management of these meadows, is, never to flow them till the middle or latter end of March, excepting once or twice in the winter, when such floods happen, as bring down a great deal of soil from the upper lands: for then it will be of great service to let such water in upon the meadows, that the soil may settle there: but the sooner the wet is drained off after this is lodged, the greater will be the benefit done to the meadows. By letting on the water frequently, from the end of March to the middle of May, the growth of the grass will be greatly assisted, and there will not then be any danger of destroying it's roots.

River water, which is universally acknowledged to be the best for this purpose, cannot be so beneficial when the stream overflows it's banks, and runs rapidly over the pastures, as when it's course is slow; and still much less than when it stagnates. It therefore is adviseable to fence in every meadow

^u *Gardener's Dict.* Art, MEADOWS,

liable to be thus overflowed, in such manner that it cannot be flooded, but at the owner's pleasure, by opening proper sluices. But as the produce of many meadows will not bear this expence, the proprietor, or farmer, should, if possible, prevent the too hasty current of the water, by raising at their upper end, or wherever else it may be necessary, such fences as shall render the water which flows sidewise upon the meadow, rather a back, or standing water. Great advantages will arise therefrom. The finer mould will no longer be carried away by the strong current of the river, which, instead of robbing the soil, will then deposit a rich sediment, and thereby greatly fertilize the land.

The water of mineral springs should not by any means be brought upon pastures; because they are either destructive of grass, or produce only a very harsh coarse kind of it.

I shall close this subject with the following remarks made by the judicious author of one of the before-mentioned dissertations in the Memoirs of Berne the Society *, and which deserve the serious attention of every husbandman who would water his pastures with due care.

“ Many people imagine, that the whole art of
 “ watering meadows consists in making good
 “ channels, and in opening and shutting the
 “ sluices at proper times. But this is not enough:
 “ for so long as the water flows in a meadow, the
 “ farmer should visit all his channels once or twice
 “ a day, with a shovel, hoe, or three-grained
 “ fork in his hand, and examine carefully whe-
 “ ther any of them want cleansing or repairing.
 “ Sometimes he will find a channel choaked with
 “ slime; in other places he will see the water

* *Tom. II. Part. I. p. 216.*

“ spread too far, or not far enough; and in
“ others again he will observe it not rise high
“ enough to overflow it's channel, so that the
“ neighbouring ground is not watered at all. He
“ will immediately endeavour to remedy these
“ defects, according to the exigency of the case,
“ whether by clearing away the muddy slime,
“ heightening the banks of the channel, lowering
“ them, giving a freer current to the water in
“ some places, and checking it's course in others,
“ according to the nature of the soil; or, by cutting
“ new channels in some places, and laying fods or
“ sluices across others, to divert the stream from
“ such parts as are sufficiently moist, and turn it
“ to others which want watering: for it frequently
“ happens that, even in the same meadow,
“ though not a large one, there are very different
“ soils, each of which requires the assistance of
“ water, but in different degrees. In short, the
“ careful husbandman will not ever visit his
“ pastures, without noticing in them things which
“ may be altered and amended.”

The farmer, who has improved his pastures according to the foregoing directions, may expect abundant recompence in plentiful crops of grass. But some farther skill is yet necessary in the management of that grass, in order to have it in the greatest perfection.

When grass is to be fed off, it should not be permitted to stand till it grows high, because the cattle will then trample under foot great part of it, which they afterwards will not eat. The prudent husbandman will also vary the kinds of cattle fed upon it, according to the principles before laid down.

When the grass is to be made into hay, the farmer will be directed in the season of mowing it, by the quality of the grass. When the crop is
very

very great, it should be cut as soon as the bottom of the grass grows yellow: for if it stands longer, more will be lost by the quantity of leaves rotted at the bottom, and the ill flavour which these will give to the rest, than will be gained by it's growth.

When other circumstances permit the choice of time, it should be when the grass is in full bloom, before the stalks begin to harden, and rather early than late; because the more sap remains in the roots, the sooner the next crop will spring up. There is not, however, any general rule for this; because, in some cases, the ripe seeds add a great value to the hay, as in sainfoin and burnet; and in others, the growth of the grass itself brings a recompense, as in the fowl-meadow grass.

A dewy or dusky morning should be chosen for cutting the grass; because, being then fullest of sap, it stands best to the scythe. When the high noon-tide sun has dried the grass, and made it recline it's head, the mower will employ his time more usefully in making the hay already cut, than in continuing to mow, with great additional labour, grass which no longer makes the due resistance.

Our farmers in general are very inattentive to the management of their hay whilst in the cock; to which is in a great measure owing the loss which they (or rather the nation) sustain every year, by the damage which the hay receives from rain.

To guard as much as possible against this accident, let the hay-makers follow the mowers, and, if the weather be quite fine, spread out the grass as fast as it is cut down, especially if it lie so thick in the swarth, that neither the air nor sun can pass freely through it: but if wet be feared, let it remain in the swarth. At night, make it into grass cocks, and the next day, as soon as the dew is off
the

the ground, spread it again, and turn it, that it may wither on the other side; then handle it, and if you find it dry, make it up into large cocks. If the weather continue favourable during the second day, the grass will, by that time, be so dry as to bear being kept in these cocks till the day on which it is to be carted, when it should be spread out again in the morning, to receive a farther drying, if wanted. If these cocks are made as tall and as taper as can be, consistent with their standing safely, the winds, by passing through them, will dry them gently and equally; and though rain should fall upon them, it will not do much hurt, because the greatest part of it will run off directly, and the sun and wind will soon dry that which may have penetrated into the cocks. These cocks have therefore a great advantage over the common small and low ones: for if a rainy season comes on, these last will be so thoroughly wetted, that the wind will not be able to pierce sufficiently to dry them. More hay is, perhaps, lost for want of making the cocks properly, than by all the rains which happen in the hay-making season.

The method here recommended is confirmed by the experience of a New England husbandman, whose account of it to the reverend Dr. Eliot runs thus,

“ I shall relate to you my own practice in making of hay, though it may seem small and trifling at the first mentioning: but finding that it saves me near two fifths of the time and labour I used to be at in this article, and that my hay is, I think, better than when I used to pursue the usual method, I esteem myself justified in communicating it to the public. My method is this. I mow my grass, and let it lie in the

y Essays upon Field-Husbandry in New England, p. 70.

“ swarth

“ swarth till the dew is off the next morning : then
 “ I turn and spread my hay, and let it lie in the
 “ sun till the after part of the day, when I take it
 “ up and cock it well, and never meddle more
 “ with it, till I cart it into my barn, or stack it.
 “ If the weather be good, it will do well to cart
 “ after it has stood two days in the cock. This, I
 “ have found by five or six years constant experience,
 “ answers for any sort of hay, except salt-
 “ hay and red clover, of which last I have not
 “ had so long trial : but with respect to clover hay,
 “ I managed it last summer after this manner,
 “ viz. I followed my mowers, as they cut the
 “ grass I spread it as thin as I could, and before
 “ night I put it in cock. The next day, after the
 “ dew was off, I spread it again ; in the afternoon,
 “ I cocked it a second time, and meddled
 “ no more with it till I carried it. The appearance
 “ of the hay since, makes me judge that no
 “ man has better of the sort. My first coming
 “ into this practice was purely accidental. After
 “ cutting my grass, five or six years ago, I put it
 “ in cock the next day ; but my avocations then
 “ were such, that I had no time in which I could
 “ possibly take any farther care of my hay for
 “ many days. When I had dispatched my other
 “ affairs, I returned to it, and found it in as good
 “ order (that is to say the bulk of it) as ever I
 “ had hay in my life. Reflecting then, how much
 “ labour may be saved by this method, I have
 “ followed the same practice ever since, and find
 “ it answer very well. The reason why I think
 “ my hay really better is, because I take it for
 “ granted, that the more juice or natural moisture
 “ we can retain in it, without corrupting and
 “ rotting the stalk, the richer and more nourishing
 “ it is. The too often turning and spreading
 “ of

“ of hay in the sun extracts too much of the
“ richness thereof, and one day’s thus lying will
“ take away such a quantity of the most watery
“ particles, as that the remainder is only sufficient
“ to raise a proper fermentation thereof when in
“ the cock, while the smallness of the body there
“ keeps that fermentation from rising to such a
“ height as to corrupt it. After twenty four hours,
“ the fermentation will gradually abate; and the
“ pitching of the hay into the cart, and afterwards
“ into the mow, or stack, so checks it, that it will
“ not again rise to such an height as to be de-
“ trimental. Cattle are fonder of this hay, than
“ of that which is made in the common way, and
“ less of it will support them.”

It would be almost needless to observe, that no narrow wheels should ever be brought upon pastures, not even in the driest season of the year, as that of hay-making generally is. The advantages of broad wheels, which help to roll and level the ground, and render the draught much easier, whether on grass, or any other soil in which narrow wheels will sink, have been confirmed by experience; and are as self evident, as it is that the latter crush and bury, and thereby destroy great numbers of the plants of grass, wherever they are dragged.

If the hay has sweated a little in the cock, there will be the less need for it’s sweating afterwards in the rick, where it will then lie so much the closer, and consequently keep the better.

SALT MARSHES are generally very rich land; but they most commonly lie so flat, that it is necessary for the owner to keep all the water he can from them. The sea water, in particular, should be fenced off as much as possible; and this is usually done at a very great expence, by high
banks,

banks, walls, and sluices, as described in the first volume of this work².

The two things chiefly wanting in these lands are, good shelter for the cattle, and fresh water; both of which the industrious farmer may obtain, at least in a great measure, by digging, in proper places, large ponds to receive the rain water, and by planting trees and hedges towards the sea, where they will not only afford shelter to the cattle, but keep off the sharp winds which often cut away the tops of all the grass, and leave the ground as bare as if it had been mowed. It would likewise be of great service to divide the marsh into different inclosures, by making banks covered with hedges, and such trees as delight in a moist soil; for these will add much to the warmth, and become very profitable by their cuttings. These lands fatten all sorts of cattle the soonest of any, and preserve sheep most effectually from the rot.—Of this, I have just received an indisputable attestation, in the following paragraph of a letter from my worthy correspondent in Lincolnshire.

“ In the marshes in this county (Lincolnshire),
 “ which were recovered from the sea, sheep never
 “ rot: nay, if a sheep is tainted, and sent to the
 “ marshes, the rot will proceed no farther. This
 “ is attributed to the salt; and I have heard of a
 “ farmer who drove his sheep into the sea, and
 “ made them swallow sea water, which had the
 “ same effect.

“ I will just mention,” continues the same generous friend to mankind, “ a receipt to prevent,
 “ or stop, the rot, where neither salt marshes, nor
 “ sea water, can be come at.

See p. 143. — 148.

“ Steep

“ Steep a handful of rue in a pail of water all night, and at morning put in as much salt as will make it bear an egg. Give each sheep half a pint of this liquor, and repeat it thrice, every other morning.

“ A farmer who kept four hundred sheep tried this receipt in the last general rot (about five years ago), and did not lose any, though his neighbours lost almost all theirs. For the sake of the experiment, he set apart about twenty, and did not give them this drink. — Many of these were rotten.”

When the farmer is obliged to feed his cattle with such coarse hay as they are not fond of, he will do well to mix salt with it, in the proportion of two pounds to an hundred weight, as advised in a memoir presented to the Berne Society^a. This will quicken their appetite, and may be a means of preserving their health.

The American *black grass*, as it is called, and of which the reverend Dr. Eliot was so kind as to send me the following account, some time ago, would probably be a vast improvement to our salt marshes, in which we have not, so far as I have been able to learn after repeated inquiries, either that sort, or any other that promises to be equally beneficial. It would therefore be well worth the while of those who are possessed of such marshes, to procure seeds of it from New England, from whence our excellent Society for the Encouragement of Arts, &c. has commissioned, but not yet received, a quantity of them.

“ We have,” says that late most respectable clergyman, in one of the letters with which he was pleased to honour me, “ an excellent sort of grass in our salt marshes. It thrives best, and

^a *Memoirs et Observations pour l'année, 1762. Part. I. p. 103.*

“ grows

“ grows largest, in those meadows which border
 “ on tide rivers, and have the greatest mixture of
 “ fresh water. Where the water is very salt, it is
 “ not apt to fix and spread; but will remain short
 “ and poor. It is very tender, and cuts as easily
 “ as garden cives, grows thicker and taller than
 “ the common salt marsh grass, and affords from
 “ two to three tons of hay to the acre: but it
 “ is a slow grower, after it has been cut. It’s
 “ seeds are small; like those of tobacco. The
 “ colour of this grass is a very deep green, which
 “ renders it so conspicuously different from every
 “ other kind, that it is universally known by the
 “ name of *black grass*.

“ This species introduced itself long since the
 “ settlement of New England. Our first planters
 “ knew nothing of it; nor has it yet travelled
 “ very far south-west. It’s first appearance in this
 “ colony was on a marsh at Seabrook, to which an
 “ old boat was brought down Connecticut river
 “ by a great flood, and there cast up. This in-
 “ clined me to think, that it was originally an in-
 “ land grass, which happened to suit with such
 “ salt marshes as are well supplied with fresh
 “ water; and what confirms me in this opinion is,
 “ that a person in the town of Killingworth,
 “ where I reside, having cleared a swamp far
 “ distant from salt water, and afterwards sent into
 “ this fresh meadow cattle which had been fod-
 “ dered with hay of the black grass, had there in
 “ in a short time (undoubtedly by means of it’s
 “ seeds carried thither in the dung of those cattle),
 “ a fine growth of this very grass, which has since
 “ not only established itself, spread, extended, and,
 “ like a conqueror, beaten out the natural grass;
 “ but looks as flourishing in that fresh meadow,
 “ as any growing on a salt marsh.

“ I have

“ I have a large tract of peat meadow, in which
“ no grafs feeds will grow. I defign to try the feed
“ of this black grafs in that dead fresh meadow,
“ fince the other forts which I have tried do not
“ fucceed. What encourages me to this, is my
“ having introduced it into a once ufelefs worth-
“ lefs morafs, worfe indeed than nothing, though
“ of confiderable extent, for I was obliged to be
“ at the expence of fencing it, for the fake of
“ other land. It was quite over-run with reeds,
“ bufhes, and brakes.

“ Between this land of mine, and a creek of
“ falt water, intervened three meadow lots be-
“ longing to other perfons. I obtained leave of
“ the owners to cut a ditch fix feet wide through
“ their ground, and carried this ditch to the
“ upper end of my land, where feveral crofs
“ ditches were then dug, to invite in, and retain,
“ the falt water. The gaping mouths of thefe
“ numerous ditches foon occafioned a ftrong in-
“ draught of falt water, and, in time, converted
“ the main ditch into a proper tide creek. The
“ falt water thus introduced has done wonders.
“ It has not only killed the trees, bufhes, brakes,
“ and levelled great inequalities, but has alfo in-
“ troduced the black grafs, and thereby rendered
“ the acre of that land, which was not worth any
“ thing before, now worth thirty five pounds of
“ our currency.

“ The falt water, in it's paffage through my
“ neighbour's grounds, has alfo done them great
“ fervice, by introducing this black grafs; and all
“ this with fmall expence.”

A P P E N D I X,

Concerning the culture and uses of

THE ANJOU CABBAGE-SHRUB.

AS this subject has already been touched upon*, though but slightly, for want of sufficient information; I must beg the reader's pardon for resuming it here, in order to give him the following much more satisfactory account of the culture of this very useful plant, with which I have since been favoured by the Marquis of Turbilly.

“ The Anjou cabbage-shrub is one of the most useful leguminous plants, for country people. It will grow in almost any soil, not excepting even the most indifferent, provided it be sufficiently dunged. It is but little known about Paris, and in many other places, where it might be cultivated to great advantage.

“ The seeds of this cabbage are commonly sown in June, in a quarter of good mould in the kitchen garden, which is watered from time to time in case of drought. They will rise pretty speedily, and should be thinned soon after, wherever they stand too thick. The next care is to keep them free from weeds whilst they grow, by hoeing the ground between them. At All-saints, they should be transplanted into the field where they are to remain. They should be planted there in trenches dug with a spade, pretty deep; that is to say, they should be buried almost up to the leaves. The distance

* See page 194.
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“ between them should be two feet, or two feet
“ and a half, every way, according to the good-
“ ness of the soil. Particular care should be taken
“ never to plant them with a dibble, as gardeners
“ plant other sorts of cabbages. A layer of dung
“ should be spread along the bottom of the trench,
“ and the roots of the transplanted cabbages
“ should be covered therewith. The mould taken
“ out should then be returned back upon this
“ dung; and, as the trench will then no longer
“ hold it all, there will remain a ridge between
“ each row of cabbages.

“ Towards the middle of the next ensuing
“ month of May, the ground should be well
“ stirred between the plants, with a spade, or some
“ other proper instrument, and it's whole surface
“ should then be laid quite level. After this,
“ nothing more remains to be done, except pull-
“ ing up the weeds from time to time, as they
“ appear.

“ Many husbandmen sow the seeds of these
“ cabbages with those of hemp; and though this
“ way be not so sure as the former, it often suc-
“ ceeds very well, especially in wet years. When
“ the hemp is pulled up, one finds a multitude of
“ little cabbages, which, having then a freer air,
“ afterwards grow apace. They are transplanted
“ at All-saints, in the manner before directed, and
“ are preferred to those of the kitchen garden,
“ because they are not so apt to run up to seed
“ the next spring: for that is an accident which
“ happens sometimes to some of these cabbages,
“ in certain years; and it then becomes necessary
“ to replace them by others which have not run
“ up, and which are reserved for this purpose in a
“ separate spot of ground.

“ Several farmers use a plough to cut the trench
“ for transplanting these cabbages: but then they
“ do not remove them till the spring, and leave
“ them

THE ANJOU CABBAGE-SHRUB. 421

“ them in the mean while in the place where they
 “ were sown. They afterwards give the earth a
 “ stirring with a spade, and lay it smooth, towards
 “ the end of May, in the manner before directed.
 “ One sees in many farms in Anjou and Poitou,
 “ whole fields of these cabbages, which are a very
 “ great resource.

“ In the month of June, such of these cab-
 “ bages, which are already large, as do not turn
 “ in their leaves for cabbaging, but still continue
 “ green, begin to be fit for use, and soon arrive at
 “ their greatest perfection, which they retain till
 “ the next spring, when they begin to run up,
 “ and afterwards blossom. Their seeds ripen to-
 “ ward the beginning of July, and what is intend-
 “ ed for sowing should be gathered then.

“ In Anjou, when these cabbages are entirely
 “ run up, they generally grow to the height of
 “ seven or eight feet: sometimes they reach to
 “ eight feet and an half high, or nine feet; and
 “ even yet taller ones have been seen.

“ From the month of June, when these cabbages
 “ begin to be fit for use, their leaves are gather-
 “ ed from time to time, and they shoot out again.
 “ They are large, excellent for soup, and so tender
 “ that they are dressed with a moment's boiling.
 “ They never occasion any flatulence, or uneasi-
 “ ness in the stomach, and they are also very good
 “ food for cattle, which eat them greedily. They
 “ likewise increase greatly the milk of cows.

“ Such are the properties of this kind of cab-
 “ bage, greatly esteemed in Anjou, Poitou, Bri-
 “ tany, the Maine, and some other neighbouring
 “ provinces. In Anjou, farmers are even bound by
 “ their leases, to plant yearly a certain number of
 “ these cabbages, and to leave a certain number
 “ of them standing when they quit their farms.

“ This cabbage forms a kind of shrub, the great
 “ utility of which may be gathered from this;

“ that it's leaves afford nourishment to men and
 “ cattle, and it's stalk, which is about the thick-
 “ ness of one's wrist, is used for fuel, when dry.
 “ It therefore is a common saying in Anjou, that
 “ every one of the cabbages is worth five sols (two
 “ pence halfpenny) a year.

“ It sometimes happens, in extremely severe
 “ winters, that some of these cabbages are frozen ;
 “ and this is looked upon as a great loss, in the
 “ countries I have been speaking of : but that
 “ accident is rare ; because this kind of cabbage
 “ resists frost better than most others.

“ The ground where these cabbages are planted
 “ should be fenced in very carefully, by hedges, or
 “ ditches, in order to preserve them from the de-
 “ predations of cattle, which are extremely fond
 “ of them. With this precaution, I have made
 “ several plantations of them near the houses
 “ which I have built in the midst of the heaths
 “ and commons that I have broken up and im-
 “ proved ; and they have succeeded well, though
 “ the soil is but very indifferent in many places.

“ I have, near my house in Anjou, two well in-
 “ closed fields, destined for this sort of plantation.
 “ They are planted alternately, every year, with
 “ young cabbages. When these are pulled up,
 “ after they have seeded, in the second year, at
 “ the time before mentioned, the ground where
 “ they stood is dug up, and sowed with peas or
 “ beans, the crop of which being taken off before
 “ All-saints, makes room for planting of new
 “ cabbages, at the proper season. The soil is
 “ loosened and enriched by the peas and beans,
 “ and by this means the land is never rested ;
 “ nor is it ever exhausted, because it is dunged
 “ whenever the cabbages are planted.

“ These cabbages are of such excellent service
 “ to me, that I have often wondered at their not
 “ being

“ being cultivated in all the different countries
 “ of Europe. I believe they would succeed every
 “ where; and I advise all husbandmen to make
 “ plantations of them. As their seeds are not
 “ yet sold at Paris, the best way will be to pro-
 “ cure them from one or other of the above named
 “ provinces; and there, to be the surer of them,
 “ from actual farmers.

“ I wish that this short memoir, founded on my
 “ own experience, may contribute to extend the
 “ culture of this very useful plant.”

*Reference to a drawing of M. de Lille's Scythe for
 mowing Wheat.*

N. B. Several gentlemen, and particularly a
 most illustrious Society, to the least intimation of
 whose desire the greatest deference is due, having
 wished to see, in this work, a drawing of M. de
 Lille's scythe for mowing wheat (described in
 p. 381, of my first volume); I have, with plea-
 sure given it in *Plate IV. Fig. 8.* of this volume.

C H A P. V.

OF INCLOSING.

THE inclosing of lands, and dividing them into different fields, pastures, &c. is a most essential part of their real improvement, and attended with many very considerable advantages; of which I shall here mention only the following.

Inclosures ascertain to every man his just and due property, and thereby prevent an infinity of trespasses, injuries, and other sources of ruinous litigation. They keep the land warm, and add to it's fertility, by screening it from violent and nipping winds, which otherwise frequently destroy whole crops; and they also defend it from those drying and scorching winds, which so often blast at once the husbandman's, till then well grounded, expectation. They afford shade in the summer, and shelter in the winter, for cattle which would otherwise destroy more with their feet, than they eat with their mouths, and which for want of these, might, as Mr. Worlidge observes^a, lose more of their fat or flesh in one sultry day, than they gain in three cool ones. Their cuttings afford fuel to the industrious husbandman, and, if carefully planted and preserved, they will here and there furnish him with timber for his carts, ploughs and other utensils, besides, sometimes, useful fruits. They are an excellent encouragement to good husbandry, and a great remedy against beggary, by employing many poor people in the labour which either the making or

^a *Systema Agriculturae*, p. 11.

the mending of them constantly requires, and which is amply repaid by the increase of crops: for it has been remarked, not only that well inclosed countries generally maintain treble the number of inhabitants, or more, than the champaign; but also, that those inhabitants are much better fed, and clad, than the common run of people in uninclosed lands.—To be convinced of this, let any one but examine our vast downs, commons, heaths, wastes, and unimproved forests; badges yet remaining, as Mr. Worlidge properly terms them, of poverty and idleness: but at the same time, thoroughly susceptible of being converted, with proper care, into corn and pasture fields, meadows, gardens, orchards, and pleasant groves; the marks of industry and good husbandry. Let him but compare the naked parts of Wiltshire, Gloucestershire, Hampshire, Surry, &c. with the delightful parts of Kent, Herefordshire, and other counties; and he cannot but be struck with a demonstration of the immensely valuable improvements which may yet be made in very many parts of this kingdom. The now unimproved, unoccupied, crown lands, might, alone, or even only a part of them, be rendered an inexhaustible source of unequalled wealth to the Sovereign, of a vast increase of his subjects, and of happiness to all.—Objects surely well worth the attention of the Legislature! especially after the long and expensive war in which this nation has been engaged, and to which OUR KING has put a most glorious end.

The common objections against inclosures have been so well refuted by many very able writers, and are daily invalidated by that most unerring test, experience, that it would be needless for me to recapitulate them here. I therefore shall only

point out one farther essential advantage attending this great improvement, which is, that it enables the farmer to act as is most agreeable to him, in sowing when, and what, he pleases.

Every gentleman whose estate is not yet inclosed, and who is consequently at liberty to choose the manner and means of doing it, will rationally begin with having a map of it drawn, that he may thereby be enabled to divide and portion it out, with the greater propriety and precision, so as to render it most pleasing to the eye, and most convenient to each farmer. If he has a place of residence upon it, he may make the whole become ornamental to that residence, by a judicious disposition of his hedges and plantations; as has been nobly done at Boughton, in Northamptonshire, by the late Duke of Montague, who, with a most refined taste, and truly benevolent mind, disdaining all the little and confined ornaments of a park, executed his fine improvements there in such a manner as to render them pleasingly beneficial to all his neighbours, as well as to every person settled upon his land.——Gubbins, in Hertfordshire, the seat of Sir Jeremy Sambrook, is another charming example of elegance, though less extensive than the former.

Ah-ha walls, and pieces of water with rails running across them, are an easy means of preserving a fenced level.

The farms should be so divided, that the dwelling of each tenant may be as contiguous to his land as conveniency will admit of; to prevent length of carriage, and to facilitate his due attendance.

Small farms have always been observed to yield the greatest proportional rent, and small inclosures constantly produce the most plentiful crops.

Inclosures for arable land should be larger than for pastures; that the soil may be kept dry, and the corn be well aired: for this will contribute greatly to prevent mildew, and other distempers arising from too much moisture.

As forest trees, by their shade and wide extended roots, are found to be manifestly injurious both to corn and grass, none of them should ever be admitted into the hedges which divide fields: but, as they are useful and necessary, the landlord should rather skirt his estate with plantations of them, or divide it by such plantations, so as to give it warmth and ornament.

In countries where, in lieu of hedges, the fences are chiefly made of rough flakes of stone piled dry one upon another, with either a little clay at the top, to keep them together, or a little earth thrown in between their chafms; a plantation of trees within these will hide their deformity, and give a warmth which is not to be expected from such walls.

The most useful way of inclosing land is with a ditch and a bank set with a hedge, of hawthorn, crabs, black-thorn, holly, or, which is more common, of white-thorn, or quick. Mr. Miller's directions in this respect are very ample, and contain, among others, the following useful instructions^b.

“ It will be proper, before planting, to consider the nature of the soil, and what sorts of plants will thrive best in it; and also what the soil is from whence the plants are to be taken: for if the ground they are taken from is better than that into which they are to be put, it will be more difficult to make them grow. Those which have been raised on a spot near the place where they are intended to be set, will always do best, if they

^b *Gardener's Dict.* Art. FENCES, and HEDGES.

are to be transplanted; and the next to them will be such as are taken from a nursery.

"I would recommend the white-thorn, the black-thorn, and the crab, for outward fences to good ground; but I do not approve of intermixing them.

"The white-thorn is the best quick to plant, because it is the most easily procured, is very hardy and durable, and may be rendered the closest of any fence, by proper clipping. It therefore is preferred to all others for outward fences, or for the division of fields, where they are exposed to cattle, &c. It may be raised either from sets or from seeds. The former is the most common way of propagating it: for the latter, which may very properly be sown where the hedge is intended to stand, do not rise till the second spring. The white-thorn will thrive on almost any well loosened soil, except the driest gravel or sand.

"The black-thorn and crab make very good fences, and are to be raised in the same manner as the white-thorn: but if the kernels of apples or crabs be sown, it is best to sow the pommace with them; for they will then come up the sooner, that is to say, the first year.

"The black-thorn is not accounted so good for fences as the white thorn, because it is apt to run more into the ground, and is less certain as to the growing: but, on the other hand, it's bushes are much better, and more lasting, than those of the white-thorn, or indeed any other shrub, for dead hedges, or to mend gaps: nor are they subject to be cropt by cattle, as the others are. The richer the mould is, the better the black-thorn will prosper: but it will grow on the same sort of soil as the white-thorn.

"The holly makes an excellent fence, and is preferable to all the rest; but it is difficult to be made

made to grow at first, and is a slow grower. However, when it does grow, it makes amends by it's height, strength, and thickness. It delights most in strong grounds; but will grow upon the driest gravel, even among rocks and stones. It is raised from sets, or berries, as the white-thorn is; and these berries, like the hawes of the white-thorn, lie till the second spring before they come up. These two are best sown in the place where they are intended to stand. They should be well weeded, both before they come up, and afterwards, till they are grown to such a size, as, of themselves, to kill the weeds.

“ French furze will make good hedges upon dry sandy banks, where few other plants will grow: but they must be kept very clean at the bottom, and never suffered to grow too high: nor should they be clipped either in dry weather, late in autumn, or early in the spring; because the cutting of them then is apt to make them die in patches, which are irrecoverable; as no new shoots will here ever proceed from the old wood.

“ Alder planted on a bank, the side of which is washed with a river or stream, will make an extraordinary fence, and preserve the bank from being undermined by the water; because it is continually putting forth, from the lower roots, suckers which are of great advantage where the current washes away the earth.

Sticks of elder, ten or twelve feet long, stuck sloping in a bank, so as to form a kind of chequer work, will produce the quickest, though not the strongest, hedge of any thing, and will be a good shelter.

“ If there is to be a ditch along the hedge, that ditch should be at least six feet wide at top, three feet deep, and but one foot and an half over at the bottom, that each side may have a proper slope: for where it's sides are dug too perpendicular,

cular, they are very apt to fall in after a hard frost, or heavy rain; and if the ditch is made narrower than here directed, it will soon be choaked up in autumn, by the falling leaves, and the growth of weeds: nor will it be a sufficient defence to the hedge against cattle.

“ When the bank at the side of this ditch is to be planted with quicks, the sets ought to be about as thick as a goose quill, and their tops should be cut off to within four or five inches of the ground. They should be fresh taken up, strait, smooth, and well rooted. Part of the turf taken off the surface of the ground where the ditch is to be dug, should be laid, with the grass side downward, on that side of the ditch where the bank is intended to be made, and some of the best mould should be laid upon it, to bed the quick. The sets of quick, prepared as before directed, are then to be laid upon that mould, a foot asunder, with their cut ends sloping somewhat upward. When this first row of quick is thus laid, it must be covered with mould; some of the remaining turf must then be laid upon that mould with the grass side downward, as before; and more mould must afterwards be laid upon this turf. When the bank has, by these means, been raised about a foot high, a second row of sets should be laid in the spaces between the lower quick, and with their ends turned the opposite way, in order to thicken the bottom of the hedge. These are then to be covered in the same manner as the former: the bank is to be topped with the bottom of the ditch; and a dry, or dead, hedge must be made on the other side, to defend the young plantation from cattle.

“ To make these dead hedges, stakes should be driven into the loose earth, so low as to reach the firm ground. They should be about two feet and

an

an half asunder. Oak stakes are reckoned the best, and black-thorn and fallow the next. When these are fixed, small bushes should be laid at the bottom, but not too thick; for that would make the bushes rot. The upper part of the hedge should be laid with long bushes, to bind the stakes in, by interweaving them: and, to render this hedge yet stronger, it may be eddered, as it is called, that is to say, the tops of the stakes may be bound in on each side with slender long poles or sticks. When this eddering is finished, the stakes should be driven anew; because that, and the weaving of the hedge, will probably have loosened them.

“ The quick must be kept constantly weeded, and secured from being cropped by cattle, and in February it should be cut to within an inch of the ground: for this will make it shoot strong, and greatly help it's growth.

“ When a hedge of this kind is about eight or nine years old, it will be proper to plash it; the best time for which is in October or February.

“ After it has stood twenty or thirty years, and there are in it old stubs, as well as new shoots, those stubs should be cut sloping off within two or three inches of the ground, excepting the best and longest of the middle size, which should be left to lay down, and some of the strongest, which should be cut off at the height of five or six feet, according to the intended height of the hedge. These last may be left to serve instead of stakes, and fresh stakes should be put wherever they are wanted. The hedge should be thinned, so as to leave on the stubs only such shoots as are designed to be of use, that there may be room left to put a spade in between them, in order to give the earth as good a stirring as can be. The ditch

also

also should be cleansed, and it's slopes carefully repaired; and where the earth has been washed from the roots of the quick, or is hollow, it should be faced anew with so much of the first spit of earth that is dug out of the ditch, as there is occasion for. The second spit of this earth should be laid on the top of the bank: for if it be laid on the side, or face of the bank, it will slip into the ditch again when wet comes, and perhaps drag down a great deal of the bank.

“ Two extremes are to be avoided in the plashing of quicks: the first is, laying the plashe down too low, and too thick; because that makes the sap run wholly into the shoots, and leaves the plashe without nourishment, which, with the thickness of the hedge, kills them. The second is, not to lay them too high; because this draws all the sap into the plashe, stints the shoots at the bottom, and renders the hedge so thin, that it will neither hinder cattle from going through, nor from cropping of it.

“ When the shoot designed to be plashed is bent, give it a small cut with a bill, half through, slanting a little downward; then weave it about the stakes, and trim off the small superfluous branches that straggle too far out on either side of the hedge.

“ If the stubs are very old, cut them quite down: secure the chasms with a good dead hedge on each side, till the young shoots are got up tall enough to plash; and plant new sets in the vacant spaces.

“ If the bank for a fence be without a ditch, and it is intended to make a hedge of quicks, the sets, prepared as before, should be planted in two rows, almost perpendicular, at the distance of a foot from each other, in the quincunx order; so that, in effect, they will be but six inches asunder.

When

When the plants of the thorn are themselves stunted, or much decayed, as they generally are pretty soon, through the unmerciful wounds given them by unskilful hedgers; instead of plashing them, the farmer's best way will be to dig them up, and plant young sets in their stead. The only inconvenience attending this renewal, is the expence of a dead hedge, which is not wanted in plashing: but I question much, whether the healthiness of the plants, when cut smooth, and in such a manner as not to retain water, may not sufficiently compensate that charge. For the same reason, it seems to me most rational to cut the plashes upward; because the wound will then be covered from the wet, at least in some degree, by the slip which remains prominent over it.

Besides the plants already mentioned for hedges, the sweet-briar, or eglantine (dog-rose), is thus recommended by a correspondent of the Society of Improvers in the knowledge of Agriculture in Scotland, who had tried in vain, in that country, all the methods of fencing usually practised in Hampshire and Essex.

“ Observing that no creature eat up or destroyed the sweet-briar or eglantine (dog-rose), I gathered the hips of this plant, and laid them in a tub till March: the seeds then rubbed out easily, and I sowed them in ground prepared for garden-peas. By this means I got my crop of peas without prejudice to my briars, which came up the next year; and the year after, when they were about a foot high, I planted them in the following manner.

“ After marking out my ditch, I laid my plants about eighteen inches asunder upon the side of the ditch, and covered their roots with the first turfs

“ that were taken off the surface of the intended
 “ ditch. The earth side of these turfs was placed
 “ next to those roots, and upon the turfs was
 “ laid other earth, taken out of the ditch, which
 “ I then finished. In four or five years, these
 “ plants made a fence which no sheep, cattle, or
 “ horses could pass. If old briars are dug up, and
 “ divided, they make excellent plants. Where the
 “ fences are thin, they may be easily thickened,
 “ by laying down branches; for these will make
 “ shoots of six or seven feet in a year. They bear
 “ clipping very well.

“ In sandy places, I seldom dare to throw all the
 “ earth out of the ditch at once, but wait a year,
 “ till what I had thrown up is settled and swarded
 “ a little: then I raised my bank to the intended
 “ height. In the mean time nothing hurts my
 “ briars; and in two or three years after they have
 “ been planted, nothing can pass the fence. Sheep
 “ sometimes attempt it: but they soon are so in-
 “ tangled, that they would lie there till they die,
 “ if they were not taken out.”

In the hedges which divide the farmer's fields only, fruit trees may be planted; and these will yield profit, as well as ornament: or the fruit may be grafted upon a stock in the hedge, properly suited thereto.

These stocks should be pruned up every year, till they are brought out of the reach of cattle, and then they may be grafted with the red-streak, gennetmoil, or any other fruit. If they have proceeded from apple-kernels, they may remain ungrafted, and will yield very good cyder fruit: but then it will be longer before they bear. Also, if the leaf, shoot, and bud of a natural stock promise more than common, a trial may be made, whether that stock will not perhaps produce a fine new fruit;

fruit; and if it be not liked afterwards, it may then be grafted ^a.

Mr. Miller reckons the plants raised from the kernels of the small wild crab much better for hedges, than those which are raised from the kernels of any other sort of apple; because the former never shoot so strong as the latter, and therefore may be better kept within the proper bounds of a hedge; and as they generally have more thorns upon them, they are better guarded against cattle.

Fences made in marshy grounds require plants which delight in moist soils. Of this kind are, particularly, the black alder, the willow, and the poplar: the birch tree, and the ash will likewise grow very well in such places: but the first of these, *viz.* the alder, is reckoned the best and most profitable.

It likes a soil so moist as few other trees will thrive in, and is propagated either by layers, or planting of truncheons about three feet in length. The best time for planting these last is in February or the beginning of March, when they should be sharpened at their larger end, and the ground should be well loosened before they are thrust into it, lest the bark should be torn off, which may occasion their miscarriage. They should be set at least two feet deep, to prevent their being blown out of the ground by violent winds, after they have made strong shoots; and they should be kept clear from all such weeds as grow tall, at least till they have got good heads: after this, they will keep down the weeds, and require no farther care.

If alders are raised by laying down the branches, this should be performed in October, and by the

same time twelvemonth they will have roots sufficient to be transplanted, which must be done by digging a hole, and loosening the earth in the place where each plant is to stand. The young sets must be planted at least a foot and a half deep, and their top should be cut off to within about nine inches of the ground; for this will make them shoot out many branches.

The alder tree may be trained into very thick close hedges, to the height of twenty feet and upwards. It will thrive exceedingly on the sides of brooks, for it grows best when part of it's roots are in the water, and may, if planted there, as is usual for willows, be cut for poles every fifth or sixth year. It's wood makes excellent pipes and staves; for it will last a long time under ground, or in water: and it is likewise much esteemed by turners, plough-wrights, &c. and for making several utensils necessary in agriculture. It's bark yields a good black dye.

All the sorts of willows, of which Mr. Miller enumerates fourteen^e, grow best in moist boggy land, and may be easily propagated by planting cuttings or sets, either in the spring or autumn: for these readily take root, and are of quick growth.

Those sorts which grow to be large trees, and are cultivated for their timber, are generally raised from sets about seven or eight feet long, sharpened at their larger end, and thrust into the ground by the sides of ditches and banks, where the soil is moist: but the best way is to make holes for them with an iron instrument, in order to avoid tearing off their bark. These will afford very profitable loppings every fifth or sixth year.

c *Ibid.* Art. SALIX.

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The middle sized, or long leaved red willow (*Salix folio longo sabluteo non auriculata*, Raii Syn.), and the common fallow (*Salix folio ex rotunditate acuminato*), C.B.P. 474; willow with a rounded acute-pointed leaf), have very pliable shoots, and therefore are the fittest for basket makers, for which reason they are much planted in osier grounds. The cuttings of these plants should be about three feet along, and taken from strong shoots of the former year. They are commonly thrust down two feet deep into the ground, and should be about eighteen inches asunder, if intended only for a fence; but if they are designed also for an osier plantation, the rows, in which they may still be at that distance, should be three feet asunder; observing always to plant the rows the sloping way of the ground, especially if tides overflow it; because, if the rows are placed the contrary way, the filth and weeds that will be detained by the sets will choak them up.

The best season for planting these cuttings is towards the end of February, for if they are planted sooner and a hard frost comes on, they are apt to peel, which greatly injures them. These plants are cut every year in osier grounds, and, if the soil be good, they will yield so great a crop, that the yearly produce of one acre has often been sold for fifteen pounds: but ten pounds is a common price. It therefore is great pity that willows are not more cultivated, especially upon boggy lands, where few other things will thrive. They will not, however, do so well as the alder, in very watery ground. Great care should be taken to screen the young willows from cattle; for they are fond of them, and would soon destroy them irrecoverably, by nipping off their young shoots. In wine countries, the boughs of this tree are used, either whole or split, according to their size,

for props to vines; and hoops for barrels are also made of them. The large wood, if sound, is sold to shoemakers for wooded heels, and to turners for many kinds of light ware.

The poplar may be propagated either from layers or cuttings, which will readily take root; and also from the suckers which the white sort, commonly called the *abele* tree, sends up in great plenty from it's roots. The best time for transplanting these suckers is in October, when their leaves begin to decay. These may be planted in a nursery for two or three years, to get strength, before they are planted out where they are to remain: but for planting of cuttings, the best time is the latter end of February, when truncheons two or three feet long, sharpened at their lower ends, may be thrust about a foot and a half deep into the ground, where, if the soil be moist, they will readily take root, and arrive at a considerable bulk in a few years.

The black poplar is not so apt to take root from large truncheons: wherefore the better way, with this, is to plant cuttings of it about a foot and half long, and about a foot deep in the ground. These will take root freely, and may afterwards be transplanted where they are to remain. This sort will grow upon almost any soil, but will thrive best in moist places. It therefore flourishes remarkably on the sides of rivers, ponds, canals, &c.

Mr. Miller says^f he has planted cuttings of this tree, which in four years have been bigger in the trunk than a man's thigh, and near twenty feet in height, and this upon a very indifferent soil: but in a very moist soil, it is common for these trees to shoot eight or ten feet in a season: so that

^f *Gardener's Dict.* ART. POPULUS.

where a person wants to make a shelter in a few years, there is scarce any tree so proper for the purpose as this is. The Memoirs of the Berne Society caution us not to plant poplars too much within a meadow, lest their roots should damage the grass; to which they add, that their leaves are excellent food for sheep^s.

It is rightly observed by the experienced gardener before mentioned^h, that a considerable advantage may be made by planting these trees upon moist boggy soils, where few others will thrive! There are in England many such places, which do not now bring in much money to their owners; whereas, if they were planted with poplars, they would, in a very few years, over purchase the ground, clear of all expences. But it is a too common opinion, that nothing but corn is worth cultivating in England; or if timber be planted, it must be oak, ash, or elm; and if the land be not proper for either of these, it is deemed of little value: whereas if the nature of the soil was examined, and proper plants were adapted to it, great profit might be made by several large tracts of land, which at this time lie neglected.

The wood of the poplar, and especially that of the *abele*, which is much esteemed on account of it's great whiteness, is very good for laying floors, where it will last for many years; but, being of a soft contexture, it is very subject to take the impression of nails, &c. which renders it less fit for this purpose. It is also very proper for wainscoting rooms, because it is less apt to swell or shrink, than most other sorts of wood. For turnery ware, none is equal to this for it's exceeding whiteness, and great lightness; wherefore trays, bowls, and

^s Tom. III. Part. I. p. 97.

^h Mr. MILLER, *ubi. supra*.

many other utensils are made of it; and the bellows makers prefer it for their use; as do also shoe-makers, not only for heels, but also for the soles of shoes. It is likewise very fit to make light carts; the poles of it are very proper to support vines, hops, &c. and it's loppings afford good fuel, which is a valuable article in many countries.

The birch tree, which will grow on almost any soil, be it ever so barren for other plants, thrives equally well in moist springy land, or in dry gravel or sand, though the surface be but very shallow. It has succeeded so well, even upon ground which produced nothing but moss, that it has been fit to cut in ten years after planting, when an acre of these trees has sold for near ten pounds, standing, and the after produce has been considerably increased.

The best way to cultivate this tree is to take young plants of it from the woods, where they naturally grow, and are generally found in great plenty: but in places where no young plants can be procured, they may be raised from seeds, which should be carefully gathered in the autumn, as soon as the scales under which they are lodged begin to open: otherwise they will soon fall out and be lost. These seeds are small, and therefore should not be buried deep in the ground. The autumn is the best season for sowing them; and if this be done in a shady situation, the plants will thrive better than when they are exposed to the full sun.

When young plants of birch are taken from out of woods, in order to be transplanted, they should be carefully dug up, so as not to injure their roots. The ground in which they are to be set will not need any other preparation, than

loosening it with a spade or mattock in the places where the plants are to stand, making holes to receive their roots, and closing the earth hard to them after they are set. If the plants are young, and have not much top, they will not require pruning: but if they have bushy heads at the time of their being transplanted, those heads should be trimmed, or shortened, to prevent their being shaken and displaced by the wind. After the plants have taken root, the only care requisite is, to cut down the great weeds which would overhang them. This may be done with a sickle, so as not to cut or injure the young trees: nor need it be repeated oftener than twice in a summer during the two first years: for the plants will afterwards be strong enough to keep down the weeds, or at least be out of danger from them.

These young birches may be transplanted at any time between the middle of October and the middle of March, when the ground is not frozen: but autumn is the best season for planting them in dry lands, and spring for setting them in a moist soil. The distance at which they should be planted is six feet square, that they may soon cover the ground, and by standing close draw up each other: for they will not thrive so well, if they are not pretty close, in situations where they are much exposed.

If the plants take kindly to the ground, they will be fit to cut in about ten years; and after that they may be cut every seventh or eighth year, if they are designed for broom makers only: but when they are intended for hoops, for which they are excellent, they should not be cut oftener than every twelfth year. The larger trees are often bought for turner's ware: and this wood is also used for making ox-yokes, and other instruments of husbandry. In some of the northern parts of

Europe, it is much esteemed for making of carriages and wheels; being hard and durable. In France, it is generally used for making wooden shoes. It makes very good fuel; and the author of a dissertation in the memoirs of the Berne Society says^k, that it's ashes are an excellent remedy for an *erysipelas*, or St. Anthony's fire: but he does not tell us how they are to be used.

In some places, these trees are tapped in the spring, and the sap is drawn out to make birch wine, which has been recommended for the stone and gravel; as is also the sap unfermented. The bark of the birch tree is almost incorruptible. Many houses in Sweden are covered with it, and it lasts many years. It frequently happens, that the wood of this tree is entirely rotten, and the bark perfectly sound and good.

To make a plantation of birch, in places where the young plants can be easily procured, will not cost above forty shillings an acre, and the after expence of cleaning will not exceed twenty shillings more; so that the whole will not be more than three pounds: and if the land be of so little value as not to be worth attempting to fit it for any other growth, the proprietor cannot make a better use of his money; for when the wood is cut, it will repay the disbursement with interest, and a perpetual stock will remain upon the ground. Mr. Miller says^l he has seen several of these plantations made upon land which would not let for one shilling an acre, and which has afterwards produced from ten to twelve pounds an acre, clear of the expence of cutting, every twelfth year.

The ash, of which our common sort is the most hardy, most lasting, and finest grained, and conse-

^k Tom. III. Part. I. p. 98.

^l Gardener's Dict. Art. BETULA.

quently the most valuable, will likewise thrive in low and moist places, as well as on high and dry grounds^m.

The seeds of this tree sown as soon as they are ripe, will come up the following spring; but if they are not sown till the spring; they will remain a year in the ground, which, in the mean time, should be kept clear of weeds, and not disturbed, for fear of turning out the seeds, or burying them too deep. When the plants are come up, they must be carefully weeded during the ensuing summer, and if they make good progress in the seed bed, they will be fit to transplant by the autumn; the most proper time for which is, when their leaves begin to fall. Great care should be taken not to break or tear off their roots in transplanting them; for which reason it is much better to dig them up with a spade, than to draw them out by hand, as is commonly practised, in order to have the largest only, and leave the others for a second year's growth before they are removed. But the purpose of thus separating them is very easily answered, without the danger of injuring their roots, by digging up all, and then planting them in different rows, according to their sizes. The younger they are planted out, the larger they will grow: and it is of consequence that the soil from whence they are taken, or in which they are raised, be not better than that in which they are to remain: for when any plants are raised in good land, and afterwards transplanted into worse, they very seldom thrive. The best way of all is therefore to sow them on the spot where they are most wanted: for they may easily be thinned afterwards; and it will be found that those which are

^m *Mémoires de la Société Oeconomique de Berne, Tom. III. p. 97.*
left

left standing will grow to a larger size than such as are transplantedⁿ.

People who live in the neighbourhood of ash trees may easily supply themselves with plenty of self-sown plants, if cattle have not been suffered to graze on the land: for if they can come at them, they will eat them up as fast as they appear. If, indeed, the seeds of the ash happen to fall under hedges, where they are protected by bushes, the plants will come up and thrive; and, through the ignorance, or inattention of some husbandmen, they are too frequently permitted to grow there till they have destroyed the hedge itself: for there is scarce any tree so hurtful to all kinds of vegetables, as the ash, which robs every plant of the nourishment that is within the reach of it's roots. This tree should therefore never be suffered in hedge-rows: nor should it ever be permitted to grow near pasture grounds; for if cows eat of the leaves or shoots of the ash, all the butter that is made of their milk will be excessively rank. Such is the quality of the butter which is made about Guildford, Godalmin, and some other parts of Surrey, where there are ash trees about all the pastures—In the good dairy countries, not an ash tree is suffered to grow^o.

This timber is of excellent service to wheelwrights and cartwrights, for ploughs, axle-trees, wheel-rings, harrows, &c. It is also used by cabinet-makers, when it is sound and knotty; and likewise for oars, blocks for pullies, and many other purposes.

The best season for felling these trees is from November to February: for if it be done either too early in autumn, or too late in the spring, their timber will be apt to become worm-eaten: but

ⁿ MILLER'S *Gardener's Dict.* ART. FRAXINUS, ^o *Id. Ibid.* for

for lopping of pollards, the spring is most eligible for all soft woods.

In countries where there is great plenty of rough flat stones, the fences which bound an estate, or farm, are frequently made with them. It is a pretty common practice in Devonshire and Cornwall, where they build as it were two walls with these stones laid one upon another, first two, and then one between; and as the walls rise, they fill the intermediate space with earth, beat the stones in flat to the sides, which makes them lie very firm, and so proceed till the whole is brought to the intended height. They then plant upon these walls quick hedges, and even timber trees^p, which thrive exceedingly; and they esteem these fences the best security that can be to their ground and cattle.—However, if these stones are laid rough and dry, they cannot but be disagreeable to the eye, and must certainly require frequent repairs, because they will frequently be forced out of their places, or beaten down, by cattle.

To prevent this, let such walls be built in the bottom of a ditch, made wide enough for the purpose, and sloped down on each side. The deformity will then be hid: and as the cattle cannot stand facing the wall, so as to attempt to leap over it, the stones of which it is composed will be the less liable to be beaten down. The earth taken out of the ditch may be spread on the adjacent ground, and its sides may be planted with such trees, or under-wood, as best suit the soil. If a space of several feet, proportioned to the demand which there may be for timber, is left on the inside of the fence, it will be attended with every advantage arising from a supply of that necessary commodity, without prejudice to the arable, or more valuable pasture.

^p MORTIMER'S *Art of Husbandry*, Vol. I. p. 3.

Another

Another very strong and durable fence may be formed thus, in grassy places. Dig pieces of turf, four or five inches thick, the breadth of your spade, and about a foot long. Lay these turfs even, by a line, on one side, with the grass outward, at the distance of ten or twelve inches within the mark at which the ditch, afterwards to be dug in the solid ground, is to begin. Then lay in the same manner, but with their grass sides turned out the contrary way, another row of turfs at such distance as to make a breadth of foundation proportioned to the intended height of the bank. The reason for placing these turfs thus much within what is to be the edge of the solid ground dug away on each side, is, to prevent the bank from falling in, if the ground underneath it should be any way defective. A ditch, of what breadth or depth you please, may then be dug; or the ground may be lowered on each side with a slope; in which last case there will be no loss of pasture by the fence, because it may be sowed with hay seeds, and will bear grass on both sides. Part of the earth taken out of the ditches or slopes, will fill the chasm between the rows of turf, and the rest may be scattered over the adjacent ground. Three, four, or more layers of turf may be thus placed one upon another, and the interval between them filled up as before, till the bank is brought to the desired height; only observing to give each side of it a small slope, for greater strength. The top of this bank should be about two feet and a half wide, and the whole of it should be filled up with earth to a level with the turfs, excepting a little hollow in the middle, to retain some rain. Quick sets should then be planted along this top, and they will soon form an admirable hedge. By this means, a bank four feet high, and a slope only two feet deep, will make,
besides

besides the hedge, a fence six feet high, through which no cattle will be able to force their way : for the roots of the grafs will bind the turfs together, that, in one year's time, it will become entirely solid, not a joining will appear, nor a turf can be got out ; and it will be yet much stronger, when the roots of the quick shall have shot out among it. The only precautions necessary to be observed here, are, 1. not to make this bank when the ground is too dry ; because, if a great deal of wet should suddenly follow, it will swell the earth so much as, perhaps, to endanger the falling of some of the outside ; which, however, is easily remedied if it should happen ; and 2. if the slope be such as sheep cannot climb up, to secure the young quicks, at the time of planting them, by a small dead hedge, either on or near the top, on both sides. If any of the quicks should die, which they will hardly be more apt to do here than elsewhere, unless perhaps in extreme dry seasons, they may be renewed, as in other places, by planting new ones, or by layers from those which remain.

A fence like this will do even for a park ; especially if posts and rails, about two feet high, are placed a little sloping over the side of the bank, on or near it's top : for no deer will be able to jump over this, nor can they creep through it.

This is one of the best fences to afford shelter for cattle ; and if the quick on the bank is kept well clipped, it will form a kind of green wall, pleasing to the eye.

When the bounding fence is only to guard against accidents from without, it may be made in the ah-ha manner ; only taking care that the earth be so well rammed down at the back of the wall, as that the stones may be properly supported, and bear equally.

C H A P. VI.

OF THE SITUATION OF FARMS AND
FARM-HOUSES.

THE antient writers on husbandry, who lived in warm countries, where the heat and moisture of the air had sensible, and frequently very dangerous, effects on the health of the inhabitants, were very particular in their directions for the choice of farms, or estates, and of the spots whereon houses should be built, so as to avoid the inconveniencies arising from the climate, or from the quality or situation of the ground.

Though the temperate air which we enjoy in this island renders such directions less necessary here; yet, as several places in it are remarkably sickly, and as, even in the most healthy situations, many houses and villages are built on the least healthy spots; it must be of considerable advantage to those who can make their choice, to know what sites and places ought to be avoided; and to such as are already fixed, to be acquainted with the means of correcting those inconveniencies which cannot be totally remedied.

Instructions of this kind are now full as necessary in our language, as they ever were in the Greek or Latin; the countries in which English is spoken being more extensive, and more various in their climes, than even the Roman empire ever was.

The rule which I have prescribed to myself, of treating each subject of this work as concisely and as plainly as it's nature can well admit of, will not permit me to enlarge on this article, so much as it's importance deserves, or in so full a manner as might justly be expected from an author who
should

should write (what there is great room for) a dissertation professedly thereon. Those who can have recourse to the originals from whence the following directions are chiefly taken, or to others who have expatiated largely on this important matter, will hardly rest satisfied with what can, with any propriety, come within the remaining limits of this treatise.

The sacrifices of the antient Romans shew how attentive they were even in the choice of the ground they encamped upon: much more were they so in that of the situation and nature of the place where they laid the foundations of more lasting buildings. They examined the livers of cattle fed on the spot, when they offered them in sacrifice; and if these were lived or corrupted, they offered others, as the unsoundness of the first might be owing to some casual distemper: but if they were often found to be morbid, they concluded that the air, water, or food, which the place yielded, would have a like effect on human bodies, and therefore speedily left that ground, to search for a better situation. If, after repeated trials, they found the livers good, they judged the air and food to be so likewise, and settled accordingly.

—We may still observe the good effect of this precaution, in the healthy situations of the remains of Roman encampments: for they preferred health to every other consideration.

The Romans had pleasure, as well as profit, in view, when they bought or stocked a farm; and therefore they laid it down as a rule^a, that no degree of fertility should tempt a man to purchase in an unhealthy country, nor the pleasantest situation in a barren one. “Buy too hastily”,

^a L. I. M. COLUMELLÆ, *de Re rustica*, Lib. I. c. 3. et c. 4.

PALLADI, *de Re rustica*, Lib. I. Tit. 2. et Tit. 7.

said the wise Cato^b, “ but view again and again
 “ the purchase you intend to make ; for if it be
 “ a good one, the oftener you see it, the better it
 “ will please you. Examine how the neighbour-
 “ ing inhabitants fare. Let the country it lies in
 “ be a good one ; the ways to and from it,
 “ good ; and the air temperate. Let your land, if
 “ you can choose your situation, be at the foot of a
 “ hill, facing the south, in a healthy place, where
 “ a sufficiency of labourers, of cattle, and of water,
 “ may be had. Let it be near a flourishing town,
 “ the sea, or a navigable river ; or bordering upon
 “ a good and well frequented road. Let the build-
 “ ings upon your ground be strong and substan-
 “ tial. Do not rashly condemn the methods of
 “ others. It is best to purchase from a good hus-
 “ bandman and a good improver.”

Besides the healthfulness of the situation, three other things should be particularly attended to in the choice of a farm or estate ; these are, the air, the water, and the soil. The air should be pure and temperate ; the water wholesome and easily come at ; and the soil rich^c.

The knowledge of the healthiness of the air is, as Lord Bacon observes^d, discoverable rather by experiment, than by reason or conjecture.

To examine the moisture of the air before a house is built, wool, or a sponge may be hung up in the place, and afterwards compared with some of the same, exposed in the same manner, and at the same time, in another place. According as they gain more or less in weight, the air is more or less humid.

^b *De Re rustica, Lib. I. c. 1.*

^c PALLAD, *Lib. I. Tit. 2.*

^d *Natural History, No. 777 and 937.*

The air is liable to greater alterations from heat and cold, in some places than in others; and as that inequality in the air is an enemy to health, the most equal should be chosen. This is easily determined by the thermometer, and by viewing the situation of the place; for the intermixture of hills and vallies, though pleasing to the eye, may be held suspected as to the lengthening of life, because of the variations of heat and cold.

Open places and champaign countries are judged to be healthy, where the soil is dry, not parched or sandy, where wild thyme and other aromatic plants grow spontaneously, and which is not otherwise bare, but interspersed with trees for shade. Yet the change of air in travelling, after being accustomed to it, is healthy: whence many travellers have proved long lived; as, indeed, have also such as have dwelt constantly in the same cottage.—A ruddy complexion, clear white of the eye, quick hearing, and distinct voice, are set down by Palladius^e, as marks of the healthfulness of the place where these circumstances are met with in the generality of its inhabitants.

The antients were particularly attentive to the quality of their water, and to the ease of coming at it. They advised ^f bringing into the farm-house the water of a spring which never dries up; or, if there be no such spring within the farm, to bring running water as near to it as may be; or to dig for well-water, not of a bitter or brackish taste. If neither of these was to be found, they directed large cisterns to be provided for men, and ponds for collecting and retaining rain water for cattle. They esteemed that running water is the best for

^e *Lib. I. Tit. 3.*

^f VARRO, *Lib. I. c. 11.* COLUMELLA, *Lib. I. c. 5.* PALLAD.
Lib. I. Tit. 2.

drinking, which has it's source in a hill : spring, or well-water, from a rising ground, was deemed the next best : well-water in the bottom of a valley was held to be suspicious ; and, marshy or fenny water, which creeps slowly on, was, by them, rightly looked upon as the worst of all.

That water is known to be wholesome, which has no mineral in it, is perfectly clear, has no taste or smell, deposits no slimy sediment, leaves no spots, or incrustation when boiled in copper or brass vessels, and which boils pulse in a very little time. " Rain water", says Sir Thomas Eliot in his *Castle of Health*, " is the most subtile and pure of any other water. The next is that which issueth out of a spring facing the east, that passeth swiftly among great stones and rocks. The third is of a clear river, which runneth on hard stones and pebbles. — There be divers means to try which is the best water ; for that which is lightest in poise or weight, is best ; also that whereof cometh least scum or froth when it doth boil ; also that which will soonest be hot. Moreover, dip linnen cloths in sundry waters, and afterwards lay them to dry ; and that which is soonest dry, the water wherein it was dipped, is most subtile."

As springs and well water pass through beds of sand, gravel, or small stones, these clear it of all impurities, unless there be mixed with them substances which are soluble in water. If any mineral is mixed with the water, it is unfit for the farmer's use. If it be hard, it is thereby rendered unfit for washing and some other culinary uses. This is the kind of water which gives flesh boiled in it a red colour. But even the hardest water may be easily rendered perfectly soft, and fit for any use, by mixing with it a small proportion of pot-ash, fixed salt, or, for want of these, the ashes of any burnt vegetables,

vegetables, as will be more fully directed in the article of *Brewing*.

The animal and vegetable substances which are mixed with stagnating water, putrify and taint that water. This taint is most effectually carried off by boiling, during which all the putrid particles evaporate; and whatever else remains in it will subside when it is cold. It may likewise be much mended by having air forced through it by means of Dr. Hales's ventilator; or it may be corrected by mixing with it acids, such as vinegar, juice of four fruits, spirit of nitre, vitriol, &c.

When there is neither running nor spring water, artificial springs may be made in the manner thus pointed out by Lord Bacon^a, who does not indeed say that he had experienced it himself; but it has been repeatedly tried since his time, and found to answer very well. "Upon a hanging ground, where there is a quick fall of rain water, lay a half trough of stone, of a good length, three or four feet deep in the ground, with one end upon the high ground, the other upon the low. Cover this trough with brakes, to a good thickness, cast sand upon the top of the brakes, and you will see, after some showers are past, the lower end of the trough run like a spring of water. This will continue for a long time after the rain is past; as if, says that great philosopher, the water did multiply itself upon the air, by the help of the coldness and condensation of the earth, and the comfort of the first water."——A gentleman in France, whose mansion stood on a height far from any water, was advised to make a long ditch, about a fathom deep, in the neighbouring higher grounds, and to fill it with sand; he did so, and it con-

^a *Natural History*, No. 25.

tinued to bring a plentiful supply of water, for all domestic purposes.

M. de la Hire observes, in the Memoirs of the Academy of Sciences for the year 1703, that rain water which has been purified by passing through clean sand, and is afterwards collected in subterranean reservoirs, will keep a long while without becoming putrid. He thinks this water the best that can be made use of, either for drinking, or for other æconomical purposes, because it is not impregnated with any mineral, as spring waters sometimes are. The only thing requisite in the construction of such reservoirs or cisterns is, to have a place which will hold water, made of such materials as will not communicate any bad quality to the water which is to remain there a considerable time. The first water that falls from the roofs of houses, when it begins to rain, should be thrown away; as having served only to wash the roof, which, in dry weather, is always covered with dung of birds, and other filth. He rejects snow water for the same reason; and likewise the water of rain brought by winds which pass over places infected with ill smells, as large cities, sinks, &c. He computes, that water enough for the use of any family, runs off the roof of the house which is inhabited by that family*.

The

* That illustrious ornament to his profession, the great and learned Dr. Mead, speaking of water^h, "which is of so constant service, not only for our drinks, but also in preparing
" of our flesh and bread, that it may justly be said to be the
" vehicle of all our nourishment, observes, that whenever this
" happens to have other properties than are necessary to fit it
" for this purpose, it is no wonder if in it's passage through
" the body these make suitable impressions there.

" Thus at Paris, where a part of the city is supplied with
" water from Arcueil, which is so full of stony particles,
h *Mechanical Account of Poisons, Essay VI.*

" that

The buildings on the farm should be proportioned to the produce, especially as to store-rooms

“ that even the pipes through which it runs, are in time incruusted and choaked up; Dr. Lisle has observed, that the inhabitants are more subject to the stone in the bladder, than in most other places.

“ In like manner let the gross particles, with which the water is saturated, be of any other nature, metallic, saline, &c. these, according to their various gravity, the capacity of canals, and such like circumstances, will, when they come to circulate in the animal body, be by the laws of motion deposited in one part or other. So these mineral bodies, and nitrous salts, which abound in the snowy waters of the Alps, do so certainly stuff and enlarge the glands of the throat in those who drink them, that scarce any who live there are exempted from this inconvenience †.

“ For this reason, the choice of water for drink among the ancients was by weight; the lightest being preferred, as most free from all heterogeneous bodies.

“ A great abuse committed about this city, is in chusing sometimes stagnating impure well-water for the brewing of beer, and making other drinks. Such a fluid indeed has often times a greater force and aptness to extract the tincture out of malt, than is to be had in the more innocent and soft liquor of rivers: but for this very reason it ought not, unless upon mere necessity, to be made use of; this quality being owing to the mineral particles and aluminous salts, with which it is impregnated.

“ A late author i, by searching into the first accounts of the distemper we call the Scurvy, described by Pliny k and Strabo l, under the promiscuous names of *Stomacace* and *Scelotyrbe*; and examining the authentic histories of it in later years, made by the most observing physicians in those countries where it was unhappily revived, as Olaus Magnus, Balduinus Ronserus, J. Wierus, Solomon Albertus, &c. finds that the origin of it was in all times and places charged upon the use of unwholesome stagnating waters. Then by comparing together the clayey strata of the earth about

† *Quis tumidum guttur miratur in Alpbibus?*

Juvenal. Satyr. 13.

i Dr. J. H. *Scelera aquarum: or, a Supplement to Mr. Graunt on the bills of mortality.*

k Lib. XXV. c. 3.

l *Geogr. Lib. VI.*

rooms &c. The expence of building should be such, as that, in case of accidents, one, or at most two years rent may repair them. The farm-house should be somewhat elegant, to give pleasure to it's possessors, and, as Columella adds ⁹, to allure the wife to take delight in it. It should be built on the most healthy spot of the farm, in a temperate air, such as the middle of a hill commonly enjoys, where it is neither stifling in the summer, nor exposed to the rage of winds and storms in the winter. It may be seated near a quick running river, if the banks are high, and the channels clear

P CATO, *Lib. I. c. 3.* VARRO, *Lib. I. c. 12.* ⁹ *Lib. I. c. 4.*

“ the city of Loudon, Paris, and Amsterdam, he shews, that
 “ where the water is worst, this malady is most rife. So that
 “ he has put it out of all doubt, that most of the perplexed
 “ and complicated symptoms, which are ranged under this one
 “ general name, are in a great degree owing to the ill qualities
 “ of this element.—From hence often proceed, not only pain
 “ in the limbs, livid spots in the surface of the body, ulcers, &c.
 “ occasioned by the acrimony of the undischarged moisture, by
 “ which the small canals of insensible perspiration are frequent-
 “ ly stoped and obstructed (for it is upon this score that Sancto-
 “ rius teaches us ^m, that heavy water converts the matter of
 “ transpiration into an ichor, which being retained induces a
 “ cachexy); but also many of those nervous complaints, which
 “ go by the name of hysterical and hypocondrical, may take
 “ their rise from the same source: for the before cited Sancto-
 “ rius has observed ⁿ, that the flatus or wind, so inseparable
 “ from those cases, in no other than the fluid of perspiration
 “ rude and unfinished.

“ If these inconveniencies are oftentimes not felt, at least
 “ not till towards the declining age, in strong and active habits
 “ of body; yet I am, from very good experience, assured, that
 “ they deserve consideration in weaker constitutions, and a
 “ sedentary life; especially of the more tender sex.

“ For these reasons Pliny tells us ^o, that those waters are con-
 “ demned in the first place, which, when boiled, incrustate
 “ the sides of the vessels. And that our well-waters do this,
 “ no body who looks into the common tea-kettle, can be
 “ ignorant.”

^m *Medec. static. §. II. Aphor. 6.*

ⁿ *Ibid. §. III. Aphor. 13.*

^o *Lib. XXXI. c. 3.*

of mud: but if the river is large, care must be taken to situate it so that the winds may carry off the vapour in summer, and the fogs in winter, which otherwise would prove hurtful to the health of men and cattle. The front of the house should be turned from such a river.—In a healthy situation, a house should front the south east, which is shaded during the hottest part of the day in summer, and enjoys the morning sun in the winter. A house facing westerly will have the morning fogs longer retained, and will be too much heated by the afternoon sun.—In an unhealthy situation, the front should be turned towards the north.

In southern climates, where the sun is within a few degrees of being vertical in summer, and yet the country is subject to severe cold in the winter, as is the case of some of our north American colonies, a south front is rather convenient: for in the heat of the summer, the sun, being high, passes over the roof from the east side to the west, and shines but little, or not all, in at the front windows, and very weakly, because obliquely, upon the front wall. But in the winter, being low, it shines full in at the windows, at a time when the cold renders it's cheering presence quite agreeable.

Places in this kingdom intended for defence, before the invention of cannon, were built either on rising grounds difficult of access, or where they could easily be secured by moats filled with water. Villages and farm houses were most frequently built in vallies, that they might be sheltered from stormy winds; or near brooks or rivers, for the conveniency of water.—In general, every means have not been used to provide against the inconveniencies of these situations: though, as Mr. Worlidge observes, “ were we for the future but
“ duly to observe the best situations of places, and
“ the completest methods of building, in such

“ houses as may hereafter be raised ; our England
 “ would in a few years appear a kingdom beset
 “ and adorned with curious and admirable habi-
 “ tations, possessed by noble and ingenious inha-
 “ bitants.”

Houses built on too lofty a situation are exposed to the violence of the winter's storms, and to the scorching drought of the summer: yet we too generally find them without the only shelter their situation admits of, which is, wood. The reason of this seems to be, that the inhabitants, finding that trees do not thrive well when they are first planted on dry heights, are at once discouraged. But where the plants are fenced from nipping winds while young, and protected from cattle till they become strong, such ground would be found abundantly favourable to the growth of trees which delight in a dry soil, as will hereafter be shewn fully, when I come to treat of forest trees. “ These, as Mr. Worlidge expresses it, would
 “ yield a cooling, refreshing, sweet, and healthy
 “ air and shade during the heat of summer, and
 “ very much break the cold winds and tempests
 “ from every quarter in the winter.”

One might be apt to think, from the unhealthiness of low and fenny countries, that moats full of water about houses should be prejudicial to health: yet many facts shew the contrary. In No. 310 of the Philosophical Transactions, a particular instance is given of two parishes which were surrounded with a morass, and yet were very healthy. Many houses surrounded with moats are drier than others in a seemingly better situation: for books and furniture are often less apt to grow mouldy in the former, than in the latter. Hence it would seem probable, that the unhealthiness of low marshy countries must arise, rather from the

† *Systema Agriculturæ*, p. 235.

‡ *Ibid.* p. 236.

putrefaction of animals and vegetables in flow moving or stagnating waters, than from a too great moisture of the air, occasioned by the quantity of water evaporated. Of this Dr. Pringle gives a remarkable instance in his most judicious and useful treatise on the diseases of the Army, when he says^t; "Another cause of the moisture and corruption of the air, were the inundations made about the fortified towns since the commencement of the war; which were particularly noxious upon letting the water off in the beginning of the summer, after the preliminary articles of the peace were signed. For these grounds, which were once entirely covered, being now half drained and marshy, filled the air with moist and putrid exhalations. The statesing made sensible of this, by the sickness that raged at Breda, and the neighbouring villages, gave orders to let in the water again, and keep it penned up till winter."

All physical writers point out the great danger to which health is exposed from a moist and warm air; especially if it be attended with a putrid vapour. Too much care cannot therefore be taken to guard against both. The too great moisture may probably be prevented by collecting all the waste water into deep ditches or ponds. We frequently see that ponds which have no supply of water but from rain, retain water during a very dry summer, when, according to the usual calculations of evaporations, the whole must have disappeared in half the time: from whence it seems more than probable, that the quick evaporation of water, in some cases, must arise from a heat reaching to, or affecting, the earth under the water; and that, if care be taken to make the ditches or ponds so deep that the heat of the sun should not

^t Page 63.

warm the earth at the bottom, the quantity evaporated will be but small, and such as will not be prejudicial to the health of the neighbouring inhabitants, if neither animal nor vegetative bodies are suffered to rot in them. The way to prevent this is by keeping the water free from grass, or other impurities, which may give shelter to animals, whose rotting, as well as that of the grass, or of those impurities, communicates a putrid taint to the exhalations. It is in this case necessary that the banks of the ditches or ponds be sloped as little as the strength or stiffness of the earth will permit.

Though lofty and bleak situations are too often destitute of trees, villages built in vallies are as frequently too much crowded with them; which must be attended with the inconvenience of not having a free circulation of air, to carry off the moisture arising from the earth, and perspiring from so many trees.—The antients would have built such villages on rising grounds, to avoid the too sultry heat of the summer; or they would have preserved a free circulation of the atmosphere, to prevent the bad effects of a stagnating moist air.

On the first settlement of the English in North America, they imitated our custom of building in vallies, and near rivers: but experience soon taught them, that such places are more subject to the suffocating sultry heat of the summer, and, what they little expected, to a greater severity of frost in the winter, than rising grounds generally are. I have been informed by one of the most curious and intelligent observers of the laws of nature, of perhaps any man on that continent, that the cold there, in their hardest frosts, is found to be so severe in the vallies, to a certain height, as sometimes to kill every tender vegetable, while those on the higher grounds escape. This generally takes place to a regular determined height,
above

above which the Americans now build their houses. —If I might be allowed to offer a conjecture concerning the cause of this, I should say, that the effect of the cold seems to be limited to the height to which the great moisture of the air rises at that season. In the hard winter of 1718 the same happened in this kingdom, when the frost was much less severe in its effect in the hilly countries, than in the low lands.

Dr. Pringle, in his most excellent treatise before mentioned, points out the disadvantages of planting so many trees as there generally are in most parts of the Netherlands. The same practice may be as justly blamed in many of the flat moist counties in England, especially where they border on marshes. Their speedy growth tempts the inhabitants to plant, at the sides of their ditches, willows, and other trees which delight in a moist soil, and these not only prevent a free circulation of air, but also perspire a great deal of moisture. Dr. Pringle confirms this by the following instances^a.

“ At Eyndhoven, two battalions of the guards
 “ were quartered in the town, and the third lay
 “ without, in the peasant's houses; all within the
 “ compass of a mile: yet, what was remarkable,
 “ this without the town had always three times
 “ more sick in the returns, than either of the
 “ other two; notwithstanding one of them had
 “ been very sickly the year before in Zealand.
 “ Now the height of the ground being alike in
 “ all, the difference in point of health could be
 “ ascribed to nothing, but to the greater moisture
 “ of the cottages; for in all other points, these
 “ corps were equal, as in diet, duty, and exercise. A similar case occurred in the cantonment
 “ of a regiment of foot; whereof one company
 “ being quartered in houses that stood upon a

“ heath, enjoyed a tolerable degree of health,
 “ while the rest that dwelt in a wood, were re-
 “ markably sickly. As a farther proof how pre-
 “ judicial it is to have the air confined by close
 “ plantations in so moist a country, it was observa-
 “ ble, that the Dutch camp at Gilsen, bordering
 “ on our cantonment, but lying on an open heath,
 “ preserved a good share of health, while we were
 “ at the worst.—It was not a little curious to
 “ observe^x, how the agues declined proportiona-
 “ bly with the withering and falling of the leaf.
 “ At this time less moisture ascends, and by the
 “ shedding of the leaves the villages come to
 “ be more open and perslated, and of course more
 “ dry and healthful.—While the troops were
 “ very sickly in Zealand^y, Commodore Mitchel’s
 “ squadron, which lay all this time at anchor
 “ in the channel between South Beverland and the
 “ island of Walcheren, in both which places the
 “ distempers raged, was neither afflicted with fever
 “ or flux, but amidst all that sickness enjoyed per-
 “ fect health. A proof that the moist and putrid
 “ air of the marshes was dissipated, or corrected,
 “ before it could reach them; and that a situation
 “ open to the winds, is one of the best preserva-
 “ tives against the maladies of a neighbouring low
 “ and marshy country.”

The driest spot in a low flat or fenny country
 should be chosen for a dwelling place. Even where
 there is gravel or sand on the surface, care should be
 taken that the springs do not rise high. Dr. Pringle
 points out the necessity of this caution, from
 what he observed in the lower parts of Brabant^z,
 “ which is a barren sand, where so little water is
 “ seen, that, at first sight, the country is deemed
 “ dry and healthful: but the appearance is de-
 “ ceitful; for water is every where to be found

^x Page 67.

^y Page 53.

^z Page 62.

“ at two or three feet from the surface: and in
 “ proportion to it's distance from thence, the in-
 “ habitants are more or less free from diseases.

Mr. Worlidge directs that^a, in low moist grounds, cellars should be made under the house, with good cieling; for that this will conduce much to it's dryness and healthfulness. The importance of rendering houses dry appears in many instances mentioned by Dr. Pringle: but I shall give only that in his 12th page. “ One quarter of Ghent, called “ St. Peter's hill, stands high above the rest of the “ country; and in this the barracks, having drains “ and free air, were quite dry; so that the men “ who lay there enjoyed perfect health. But the “ rest who were quartered in the low part of the “ town, where their barracks were mostly the “ ground-floors of waste houses without drains, “ and of course very damp, were all sickly.”

The bed chambers, in such situations, more especially, should be in the dryest and most elevated part of the house, and where the morning sun may contribute most to keep them dry^b. If they are so situated, that the sun does not warm and dry them, they should be frequently aired with fires; the oftener in proportion to the greater dampness of the place: for this has been found to contribute greatly to the health of the inhabitants.—I am informed by a gentleman who has experienced it in many instances, that, by this sole precaution, he has preserved several families from the ague, when that distemper was very epidemic in the neighbourhood. How much the dryness of bed-chambers contributes to health, is confirmed by what Dr. Pringle observes to have hap-

^a *Systema Agriculturae*, c. 11. §. 5.

^b COLUMELLA, *Lib. I. c. 6.*

pened at Bruges, where the soldiers that lay in the upper stories kept their health remarkably better, than those who were below on the ground floors.

As brick walls render houses dryer than those of stone, and of a more equal warmth than plaistering, Mr. Worlidge directs, that, "where bricks can be had, the walls should be built with them, as may be done for little cost, if you raise firm and strong columns at the corners of the house, and where it is necessary to support the main beams. You may build these square, and between them raise the walls with the same materials, and work them up together with the corners and columns, leaving one half of the extraordinary breadth of the column without, and the other within the walls; thereby you will save much charge in materials and workmanship, and yet your house will be firm and strong."

We are too little attentive to the situation of houses with regard to rivers; though a judicious choice in this must be of great consequence to the health of the inhabitants. A quick flowing stream, with a clean channel and dry banks, will rather add to the beauty and healthiness of a country: but oozy banks over-run with reeds, or other strong coarse grass, should be carefully avoided, as being a shelter to all manner of putrid filth, from whence unsalutary vapours must arise. It is a general opinion, that it is safer to dwell on the north, than on the south, side of such a river. Yet it has been observed by a most ingenious gentleman, whose long residence in warm climates has afforded him ample opportunities of knowing the truth, that an oozy slow moving river, or a putrid marsh, is least hurtful on the north side of

* *Ubi supra*, p. 237.

a dwelling place. The reason assigned by him is, that the southerly winds being warm, putrefaction is thereby promoted and increased in such a river, or marsh, and the vapours are also more copiously raised. These vapours do not rise high into the air rendered light by the warmth of the south wind, but rather glide along the surface of the earth, where they are moved by a gentle breeze, and so are brought into the houses, and breathed by the inhabitants, to the injuring of whose health their mischief is not confined; for they also hurt their furniture, and even their utensils of husbandry: whereas when the north wind blows, the air is generally cool, putrefaction is checked, fewer vapours arise, and these, by the greater density of the air, are sooner raised high and dissipated. Northerly winds are also generally brisker; and therefore the air has less time to be tainted in passing over such river or marsh. The same quantity of vapour arising in any given time, is diluted as it were, and its power weakened, by being mixed with a greater quantity of air. Add to this, that, possibly, the human body, being more relaxed when the warm and southerly winds blow, may then be more susceptible of the injuries occasioned by these moist and putrid exhalations.—Marshes which are sometimes overflowed with salt water, are found to be more unwholesome than fresh water marshes. Their neighbourhood should therefore be carefully avoided.

Laudato ingentia rura,—exiguum colito^d, “commend extensive demesnes, but occupy a small farm”, was a precept universally received by the antient Romans, who laid it down as a rule, that the farmer ought to be stronger than the farm, because, in the struggle which must arise between them, if the farm be too strong for the farmer,

^d VIRG. *Georg. Lib. II.* 412.

he must be ruined^e: that is, if the extent of his farm be such that he cannot bestow a due culture on every part of it, he must thereby become a loser: for, as Columella remarks^f, “it is certain that a large tract of land not rightly cultivated, will yield less than a smaller space well cultivated. — The seven *jugera*, adds he, which Licinius the Tribune of the people distributed to each man, yielded a greater increase, in proportion, than our large farms, in the manner we now cultivate them.”

This reflection may, with equal justice, be applied to this kingdom, where the landlords of late study to throw their estates into very large farms; because, say they, it lessens the expence of repairs, and diminishes the number of poor. But it may perhaps be questioned, whether the landlord does not become as great a loser by the failure of one such considerable tenant, as the expence of more numerous repairs would amount to: and that these failures must be frequent, is pretty certain; because landlords cannot always find farmers sufficiently wealthy to stock such farms without borrowing, whereby they contract a debt which remains an internal canker in their vitals, and gradually eats them up; or being young and unexperienced, their great and certain expence soon consumes their stores. — Two great evils, of a public nature, attend this practice. The land cannot be so well cultivated as it ought, and therefore cannot yield its utmost produce: and the country, that great source of population, must be unpeopled; as Italy was in Columella's time.

^e COLUMELLA, *Lib. I. c. 4.*

^f *Ibid.*

